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LIST OF MEETINGS AND PAST OFFICERS

First Annual Meeting, Washington, D. C., Nov. 12–14, 1889. President, C. V. Riley; Vice-President, S. A. Forbes; Second Vice-President, A. J. Cook; Secretary, John B. Smith.

Second Annual Meeting, Champaign, Ill., Nov. 11–13, 1890. (The same officers had charge of this meeting.)

Third Annual Meeting, Washington, D. C., Aug. 15–18, 1891. President, James Fletcher; First Vice-President, F. H. Snow; Second Vice-President, Herbert Osborn; Secretary, L. O. Howard.

Fourth Annual Meeting, Rochester, N. Y., Aug. 15–16, 1892. President, J. A. Lintner; First Vice-President, S. A. Forbes; Second Vice-President, J. H. Comstock; Secretary, F. M. Webster.

Fifth Annual Meeting, Madison, Wisc., Aug. 14–16, 1893. President, S. A. Forbes; First Vice-President, C. J. S. Bethune; Second Vice-President, John B. Smith; Secretary, H. Garman.

Sixth Annual Meeting, Brooklyn, N. Y., Aug. 14–15, 1894. President, L. O. Howard; First Vice-President, John B. Smith; Second Vice-President, F. L. Harvey; Secretary, C. P. Gillette.

Seventh Annual Meeting, Springfield, Mass., Aug. 27–28, 1895. President, John B. Smith; First Vice-President, C. H. Fernald; Secretary, C. L. Marlatt.

Eighth Annual Meeting, Buffalo, N. Y., Aug. 21–22, 1896. President, C. H. Fernald; First Vice-President, F. M. Webster; Second Vice-President, Herbert Osborn; Secretary, C. L. Marlatt.

Ninth Annual Meeting, Detroit, Mich., Aug. 12–13, 1897. President, F. M. Webster; First Vice-President, Herbert Osborn; Second Vice-President, Lawrence Bruner; Secretary, C. L. Marlatt.

Tenth Annual Meeting, Boston, Mass., Aug. 19–20, 1898. President, Herbert Osborn; First Vice-President, Lawrence Bruner; Second Vice-President, C. P. Gillette; Secretary, C. L. Marlatt.

Eleventh Annual Meeting, Columbus, Ohio, Aug. 18–19, 1899. President, C. L. Marlatt; First Vice-President, Lawrence Bruner; Second Vice-President, C. P. Gillette; Secretary, A. H. Kirkland.

Twelfth Annual Meeting, New York, N. Y., June 22–23, 1900. President, Lawrence Bruner; First Vice-President, C. P. Gillette; Second Vice-President, E. H. Forbush; Secretary, A. H. Kirkland.

Thirteenth Annual Meeting, Denver, Colo., Aug. 23–24, 1901. President, C. P. Gillette; First Vice-President, A. D. Hopkins; Second Vice-President, E. P. Felt; Secretary, A. L. Quaintance.

Fourteenth Annual Meeting, Pittsburgh, Pa., June 27–28, 1902. President, A. D. Hopkins; First Vice-President, E. P. Felt; Second Vice-President, T. D. A. Cockerell; Secretary, A. L. Quaintance.

Fifteenth Annual Meeting, Washington, D. C., Dec. 26–27, 1902. President, E. P. Felt; First Vice-President, W. H. Ashmead; Second Vice-President, Lawrence Bruner; Secretary, A. L. Quaintance.

Sixteenth Annual Meeting, St. Louis, Mo., Dec. 29–31, 1903. President, M. V. Slingerland; First Vice-President, C. M. Weed; Second Vice-President, Henry Skinner; Secretary, A. F. Burgess.

Seventeenth Annual Meeting, Philadelphia, Pa., Dec. 29–30, 1904. President, A. L. Quaintance; First Vice-President, A. F. Burgess; Second Vice-President, Mary E. Murtfeldt; Secretary, H. E. Summers.

Eighteenth Annual Meeting, New Orleans, La., Jan. 1–4, 1906. President, H. Garman; First Vice-President, E. D. Sanderson; Second Vice-President, F. L. Washburn; Secretary, H. E. Summers.

Nineteenth Annual Meeting, New York, N. Y., Dec. 28–29, 1906. President, A. H. Kirkland; First Vice-President, W. E. Britton; Second Vice-President, H. A. Morgan; Secretary, A. F. Burgess.

Twentieth Annual Meeting, Chicago, Ill., Dec. 27–28, 1907. President, H. A. Morgan, First Vice-President, H. E. Summers; Second Vice-President, W. D. Hunter; Secretary, A. F. Burgess.

Twenty-first Annual Meeting, Baltimore, Md., Dec. 28–29, 1908. President, S. A. Forbes; First Vice-President, W. E. Britton; Second Vice-President, E. D. Ball; Secretary, A. F. Burgess.

Twenty-second Annual Meeting, Boston, Mass., Dec. 28–29, 1909. President, W. E. Britton; First Vice-President, E. D. Ball; Second Vice-President, H. E. Summers; Secretary, A. F. Burgess.

Twenty-third Annual Meeting, Minneapolis, Minn., Dec. 28–29, 1910. President, E. D. Sanderson; First Vice-President, H. T. Fernald; Second Vice-President, P. J. Parrott; Secretary, A. F. Burgess.

Twenty-fourth Annual Meeting, Washington, D. C., Dec. 27–29, 1911. President, F. L. Washburn; First Vice-President, E. D. Ball; Second Vice-President, R. H. Pettit; Secretary, A. F. Burgess.

Twenty-fifth Annual Meeting, Cleveland, Ohio, Jan. 1–3, 1913. President, W. D. Hunter, First Vice-President; T. J. Headlee, Second Vice-President; R. A. Cooley; Secretary, A. F. Burgess.

Twenty-sixth Annual Meeting, Atlanta, Ga., Dec. 31, 1913–Jan. 2, 1914. President, P. J. Parrott; First Vice-President, E. L. Worsham; Second Vice-President, Wilmon Newell; Secretary, A. F. Burgess.

Twenty-seventh Annual Meeting, Philadelphia, Pa., Dec. 28–31, 1914. President, H. T. Fernald; First Vice-President, Glenn W. Herrick; Second Vice-President, W. E. Britton; Third Vice-President, Wilmon Newell; Secretary, A. F. Burgess.

Special Meeting, Berkeley, Cal., Aug. 9–10, 1915. (Officers same as for Twenty-eighth Annual Meeting.)

Twenty-eighth Annual Meeting, Columbus, Ohio, Dec. 27–30, 1915. President, Glenn W. Herrick; First Vice-President, R. A. Cooley; Second Vice-President, W. E. Rumsey; Third Vice-President, E. F. Phillips; Secretary, A. F. Burgess.

Twenty-ninth Annual Meeting, New York, N. Y., Dec. 28–30, 1916. President, C. Gordon Hewitt; First Vice-President, G. A. Dean; Second Vice-President, E. D. Ball; Third Vice-President, W. J. Schoene; Fourth Vice-President, T. J. Headlee; Secretary, A. F. Burgess.

Thirtieth Annual Meeting, Pittsburgh, Pa., Dec. 31, 1917–Jan. 2, 1918. President, R. A. Cooley; First Vice-President, W. E. Hinds; Second Vice-President, A. W. Morrill; Third Vice-President, G. M. Bentley; Fourth Vice-President, B. N. Gates; Secretary, A. F. Burgess.

Thirty-first Annual Meeting, Baltimore, Md., Dec. 26–27, 1918. President, E. D. Ball; First Vice-President, W. C. O'Kane; Second Vice-President; G. P. Weldon; Third Vice-President, E. C. Cotton; Fourth Vice-President, Franklin Sherman, Jr.; Secretary, A. F. Burgess.

Thirty-second Annual Meeting, St. Louis, Mo., Dec. 31, 1919–Jan. 2, 1920. President, W. C. O'Kane; First Vice-President, A. G. Ruggles; Second Vice-President, H. J. Quayle; Third Vice-President, E. C. Cotton; Fourth Vice-President, W. E. Britton; Secretary, A. F. Burgess.

Thirty-third Annual Meeting, Chicago, Ill., Dec. 29–31, 1920. President Wilmon Newell; First Vice-President, H. A. Gossard; Second Vice-President, E.

M. Ehrhorn; Third Vice-President, J. G. Sanders; Fourth Vice-President, F. B. Paddock; Secretary, A. F. Burgess.

Thirty-fourth Annual Meeting, Toronto, Canada, Dec. 29–31, 1921. President, George A. Dean; First Vice-President, Arthur Gibson; Second Vice-President, E. O. Essig; Third Vice-President, A. G. Ruggles; Fourth Vice-President, H. F. Wilson; Secretary, A. F. Burgess.

Thirty-fifth Annual Meeting, Boston, Mass., Dec. 28–30, 1922. President, J. G. Sanders; First Vice-President, J. M. Swaine; Second Vice-President, A. L. Lovett; Third Vice-President, R. W. Harned; Fourth Vice-President; M. C. Tanquary; Secretary, A. F. Burgess.

Thirty-sixth Annual Meeting, Cincinnati, Ohio, Dec. 29, 1923–Jan. 2, 1924. President, A. G. Ruggles; First Vice-President, H. A. Gossard; Second Vice-President, H. J. Quayle; Third Vice-President, P. A. Glenn; Fourth Vice-President, S. B. Fracker; Secretary, A. F. Burgess.

Thirty-seventh Annual Meeting, Washington, D. C., Dec. 31, 1924–Jan. 3, 1925. President, A. F. Burgess; First Vice-President, M. C. Tanquary; Second Vice-President, H. S. Smith; Third Vice-President, E. R. Sasscer; Fourth Vice-President, R. W. Harned; Secretary, C. W. Collins.

Thirty-eighth Annual Meeting, Kansas City, Mo., Dec. 29, 1925–Jan. 1, 1926. President, H. A. Gossard (died in office December 18, 1925); First Vice-President, R. N. Chapman (assumed duties of President for remainder of term); Second Vice-President, Leroy Childs; Third Vice-President, C. H. Hadley; Fourth Vice-President, R. L. Webster; Secretary, C. W. Collins.

Thirty-ninth Annual Meeting, Philadelphia, Pa., Dec. 28, 1926–Jan. 1, 1927. President, Arthur Gibson; First Vice-President, C. J. Drake; Second Vice-President, W. B. Herms; Third Vice-President, L. A. Strong; Fourth Vice-President, J. I. Hambleton; Fifth Vice-President, W. E. Hinds; Secretary, C. W. Collins.

Fortieth Annual Meeting, Nashville, Tenn., Dec. 27–31, 1927. President, R. W. Harned; First Vice-President, W. P. Flint; Second Vice-President, R. W. Doane; Third Vice-President, Franklin Sherman; Fourth Vice-President, J. H. Montgomery; Fifth Vice-President, F. E. Millen; Secretary, C. W. Collins.

Forty-first Annual Meeting, New York, N. Y., December 27–31, 1928. President, W. B. Herms; First Vice-President, J. E. Graf; Vice-Presidents, R. S. Woglum (Pacific Slope Branch); G. M. Bentley (Cotton States Branch); P. J. Parrott (Eastern States Branch); L. S. McLaine (Section of Plant Quarantine and Inspection); H. F. Wilson (Section of Apiculture); Secretary, C. W. Collins, Melrose Highlands, Mass.

Forty-second Annual Meeting, Des Moines, Iowa, December 30, 1929–January 2, 1930. President, T. J. Headlee; First Vice-President, E. R. Sasscer; Vice-Presidents, O. H. Swezey, (Pacific Slope Branch); F. L. Thomas, (Cotton States Branch); E. N. Cory, (Eastern States Branch); F. N. Wallace, (Section of Plant Quarantine and Inspection); G. M. Bentley, (Section of Apiculture); J. A. Hyslop, (Section of Extension); Secretary, C. W. Collins, Melrose Highlands, Mass. (T. H. Jones, Secretary Pro-tem for the Des Moines meeting).

Forty-third Annual Meeting, Cleveland, Ohio, December 29, 1930–January 1, 1931. President Franklin Sherman; First Vice-President, J. S. Houser; Vice-

Presidents, Don. C. Mote, (Pacific Slope Branch); J. M. Robinson, (Cotton States Branch); C. H. Hadley, (Eastern States Branch); E. N. Cory, (Section of Plant Quarantine and Inspection); R. L. Parker, (Section of Apiculture); C. R. Crosby, (Section of Extension); Secretary A. F. Burgess, Melrose Highlands, Mass.

Forty-fourth Annual Meeting, New Orleans, Louisiana, December 29-31, 1931. President, J. S. Houser; First Vice-President, W. E. Hinds; Vice-Presidents, R. E. Campbell (Pacific Slope Branch); R. W. Harned, (Cotton States Branch); W. J. Schoene, (Eastern Branch); K. C. Sullivan, (Section of Plant Quarantine and Inspection); S. W. Bilsing, (Section of Apiculture); Leonard Haseman, (Section of Extension); Secretary, A. F. Burgess, Greenfield, Mass.

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†Ackerman, A. J., Box 146, Bentonville, Ark.
Adair, H. S., U. S. Bureau of Ent., Albany, Ga.
Ainslie, C. N., 5009 Orleans Ave., Sioux City, Iowa.
†Alden, C. H., State Bd. Ent., Cornelia, Ga.
Aldrich, J. M., U. S. National Museum, Washington, D. C.
Alexander C. P., M. S. C., Amherst, Mass.
Allen, H. W., Box H., Moorestown, N. J.
Allen, R. H., Dept. of Agriculture, State House, Boston, Mass.
Anderson, Edwin J., Penn. State College, State College, Pa.
†Anderson, Wm. E., Baton Rouge, La.
Annand, P. N., Box 1100, Twin Falls, Idaho.
Arant, F. S., Auburn, Ala.
Armitage, H. M., 330 N. Broadway, Los Angeles, Calif.
Armstrong, Thomas, Ent. Lab., Vineland Station, Ontario, Canada.
†Arnold, George F., A. and M. College, Miss.
Arnold, T. A., 8 Federal Building, El Paso, Texas.

Babcock, K. W., 615 Front St., Toledo, Ohio.
Babcock, O. G., Box 407, Sonora, Texas.
†Back, E. A., U. S. Bureau of Entomology, Washington, D. C.
†Baerg, W. J., Fayetteville, Ark.
Bailey, H. L., Dept. of Agriculture, Montpelier, Vt.
Baird, A. B., 228 Dundas St., E. Belleville, Ontario, Canada.
†Baker, A. C., U. S. Bureau of Entomology, Washington, D. C.
Baker, A. W., Ontario Agricultural College, Guelph, Canada.
Baker, Howard, Box 1715, Shreveport, La.
Baker, W. A., Drawer 359, Monroe, Mich.
Balduf, W. V., 610 Michigan Ave., Urbana, Ill.
†Ball, E. D., Agr. Exp. Sta., Tucson, Ariz.

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†Members who attended 1931 meeting.

Banks, C. S., Box 2314, Manila, P. I.
†Barber, E. R., 1200 S. Broad St., New Orleans, La.
Barber, H. S., U. S. Natl. Museum, Washington, D. C.
Barnes, D. F., 712 Elizabeth St., Fresno, Calif.
Bartlett, Oscar C., Box 1857, Phoenix, Ariz.
Bartley, H. N., 22 Elizabeth St., South Norwalk, Conn.
Basinger, A. J., Citrus Exp. Station, Riverside, Calif.
Batchelder, C. H., 15 Harding Court, Melrose, Mass.
Becker, G. G., P. Q. C. A., Washington, D. C.
Beckwith, C. S., Cranberry Exp. Sta., Pemberton, N. J.
Bedford, Theo., Welcome Tropical Research Lab., Khartum, Sudan.
†Bentley, G. M., University of Tennessee, Knoxville, Tenn.
Berger, E. W., Box 656, Gainesville, Fla.
Berley, J. A., Clemson College, S. C.
Bethune, C. J. S., Guelph, Ontario, Canada.
†Bibby, F. F., Div. of Entomology, College Station, Texas.
†Bigger, J. H., 1114 So. Main St., Jacksonville, Ill.
†Bilsing, S. W., College Station, Texas.
†Bishopp, F. C., U. S. Bureau of Entomology, Washington, D. C.
Blackman, M. W., Bureau of Entomology, Washington, D. C.
Blanchard, R. A., 600 26th St., Sacramento Calif.
†Bliss, C. I., 724 Earlham Drive, Whittier, Calif.
†Bondy, Floyd F., Box 65, Florence, S. C.
Bourne, A. I., Agr. Exp. Station, Amherst, Mass.
Boyce, A. M., Citrus Experiment Station, Riverside, Calif.
Boyd, Mark F., Moingona, 615 Highland Ave., R. R. No. 2, Tallahassee, Fla.
Boyden, B. L., Indio, Calif.
Bradley, George H., Box 491, Orlando, Fla.
Brannon, C. H., State College, Raleigh, N. C.
Brannon, L. W., 128 Ohio Ave., Ingeside, Norfolk, Va.
Breakey, Edward P., Ohio Biol. Survey, O. S. Univ., Columbus, Ohio.
Brewer, Erle G., 615 Front St., Toledo, Ohio.
Brimley, C. S., Department of Agriculture, Raleigh, N. C.
Brittain, W. H., MacDonald College, Quebec, Canada.
Britton, W. E., Agr. Exp. Station, New Haven, Conn.
Broadbent, B. M., 724 Earlham Drive, Whittier, Calif.
Bromley, S. W., Bartlett Tree Research Lab., Stamford, Conn.
Brooks, F. E., U. S. Bureau of Entomology, French Creek, W. Va.
Brown, Luther, Bu. Ent., Albany, Ga.
†Brues, C. T., Zoological Lab., Harvard University, Cambridge, Mass.
Bruner, Lawrence, 3033 Deakin St., Berkeley, Calif.
Bryson Harry R., K. S. A. C., Manhattan, Kansas.
†Bulger, J. W., Bureau of Entomology, Washington, D. C.
†Burdette, R. C., Agr. Exp. Sta., New Brunswick, N. J.
†*Burgess, A. F., Greenfield, Mass.

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†Members who attended 1931 meeting. *Life members.

Burke, H. E., 1551 Emerson St., Palo Alto, Calif.
Burrell, R. W., 70 Groveland St., Abington, Mass.
Burrill, A. C., Missouri Resources Museum Com., Jefferson City, Mo.
†Butler, H. G., 909 Crescent St., Harriman, Tenn.
Buys, John L., St. Lawrence University, Canton, N. Y.
†Bynum, E. K., Box 366, Houma, La.

Caesar, Lawson, Ontario Agricultural College, Guelph, Canada.
Caffrey, D. J., 615 Front St., Toledo, Ohio.
Cagle, L. R., Experiment Station, Blacksburg, Va.
Campbell, F. L., 7710 Blair Rd., Takoma Park, Md.
Campbell, R. E., Box 297, Alhambra, Calif.
Carter, Walter, University of Hawaii, Honolulu, H. T.
Cartwright, Oscar L., Div. Ent., Exp. Sta., Clemson College, S. C.
Cartwright, Wm. B., 600 26th St., Sacramento, Calif.
Cassidy, T. P., Box 1896, Tucson, Ariz.
Caudell, A. N., U. S. Natl. Museum, Washington, D. C.
Cecil, Rodney, Box A 3, Ventura, Calif.
Chamberlin, F. S., Box 239, Quincy, Fla.
Chamberlin, T. R., Forest Grove, Ore.
Chamberlin, W. J., Corvallis, Ore. (Route 3).
†Chambers, E. L., State Entomologist's Office, Madison, Wisc.
†Chandler, S. C., Route 5, Carbondale, Ill.
Chapman, P. J., Experiment Station, Geneva, N. Y.
Chapman, R. N., University of Hawaii, Honolulu, H. T.
Childs, Leroy, Hood River, Ore.
Claassen, P. W., 102 Irving Place, Ithaca, N. Y.
Clark, Sherman Wood, Substation No. 15, Weslaco, Texas.
Clausen, C. P., Bureau of Entomology, Washington, D. C.
Cleveland, C. R., 910 S. Michigan Ave., Chicago, Ill.
Cockerell, T. D. A., 809 Tenth St., Boulder, Colo.
†Cockerham, K. L., Box 205, Biloxi, Miss.
Colcord, Mabel, Bureau of Entomology, Washington, D. C.
Cole, F. R., U. S. D. A. Lab., Whittier, Calif.
Collins, C. W., U. S. Bureau of Entomology, Melrose Highlands, Mass.
Compton, C. C., Floriculture Bldg., Urbana, Ill.
†Cook, Mel T., Insular Exp. Station, Rio Piedras, P. R.
Cook, William C., Box 488, Davis, Calif.
Cooley, Chas. E., P. Q. C. A., Washington, D. C.
Cooley, R. A., U. S. Public Health Service, Hamilton, Mont.
Corkins, C. L., University of Wyoming, Laramie, Wyo.
Cory, E. N., Agricultural Experiment Station, College Park, Md.
Cotton, E. C., R. 3, Elyria, Ohio.
Cotton, R. T., Bureau of Entomology, Washington, D. C.
Craighead, F. C., Bureau of Entomology, Washington, D. C.

†Members who attended 1931 meeting.

Crampton, G. C., Agricultural College, Amherst, Mass.
Crawford, H. G., Entomological Branch, Ottawa, Can.
Creel, C. W., University of Nevada, Reno, Nev.
Criddle, Norman, Treesbank, Manitoba, Can.
Crosby, C. R., Cornell University, Ithaca, N. Y.
Crossman, S. S., 22 Elizabeth St., S. Norwalk, Conn.
Crumb, S. E., Box 233, Payallup, Wash.
Cushing, Emory C., Golovin, Alaska.
†Cutright, C. R., Expt. Station, Wooster, Ohio.

Dampf, Alfons, Avenida Insurgentes, 171, Mexico, D. F., Mexico.
Daniel, D. M., Experiment Station, Geneva, N. Y.
Davidson, William, R. F. D. No. 1, Silver Spring, Md.
Davis, A. C., Box 35, Santa Ana, Calif.
Davis, E. W., 601 McCormick Bldg., Salt Lake City, Utah.
†Davis, J. J., Agricultural Experiment Station, Lafayette, Ind.
†Dean, George A., Kansas State Agricultural College, Manhattan, Kansas.
Deay, Howard, Purdue University, Lafayette, Ind.
†Decker, George C., Iowa State College, Ames, Iowa.
†DeCoursey, R. M., Conn. Agr. Coll., Storrs, Conn.
†DeLong, Dwight M., Ohio State University, Columbus, Ohio.
De Ong, E. R., Mills Bldg., San Francisco, Calif.
Detwiler, J. D., 844 Hellmuth Ave., London, Ontario.
†Dietrich, Henry, Inspector, State Plant Bd., Lucedale, Miss.
Dietz, H. F., Depart. of Entomology, State University, Columbus, Ohio.
Doane, R. W., Stanford University, Calif.
Dodds, C. T., 2808–7th Ave., Los Angeles, Calif.
Dohanian, S. M., 42 Cedar St., Somerville, Mass.
Doucette, C. F., Box 566, Sumner, Wash.
†Douglass, J. R., Box 353, Estancia, New Mexico.
Dove, W. E., Box 324, Charleston, S. C.
Dowden, P. B., 1156 Main St., Melrose Highlands, Mass.
Downes, W., Dominion Entomologist Lab., Dept. Agr., Victoria, B. C.
†Dozier, H. L., Service Technique, Port au Prince, Haiti.
Drake, C. J., Iowa State College, Ames, Iowa.
Driggers, B. F., Agr. Exp. Station, New Brunswick, N. J.
†Dudley, J. E., Jr., Exp. Station, Madison, Wisc.
Dunavan, David, Clemson College, S. C.
Dunham, W. E., O. S. U., Columbus, Ohio.
Dunnam, E. W., Box 750, Bryan, Texas.
Dusham, E. H., College Heights, State College, Pa.
Dustan, A. G., Entomological Branch, Ottawa, Canada.

Eckert, J. E., Div. Ent., College Agr., Davis, Calif.
†Eddy, C. O., Agr. Exp. Sta., Lexington, Ky.

†Members who attended 1931 meeting.

Ellington, Geo. W., Silver Springs, Md.
Elmore, J. C., Box 297, Alhambra, Calif.
†English, Lester L., Spring Hill, Ala.
Essig, E. O., University of California, Berkeley, Calif.
Evenden, J. C., Coeur D'Alene, Idaho.
†Ewing, H. E., U. S. National Museum, Washington, D. C.
†Ewing, K. P., Tallulah, La.
Eyer, J. R., Depart. of Biology, State College, New Mexico.
†Fackler, H. L., Knoxville, Tenn.
Farrar, Milton, D., State Ent. Bldg., Urbana, Ill.
Faxon, Richard, Box 991, San Juan, P. R.
†Felt, E. P., Bartlett Tree Research Lab., Stamford, Conn.
Fenton, F. A., Sta. A., Box 67, El Paso, Texas.
Fernald, H. T., 707 E. Concord Ave., Orlando, Fla.
Ferris, G. F., Stanford University, Calif.
Ficht, G. A., Purdue University Exp. Sta., W. Lafayette, Ind.
Filinger, G. A., Ohio Agr. Exp. Station, Wooster, Ohio.
Fink, D. E., 7710 Blair Road, Takoma Park, Md.
Fisher, C. K.., Box 24, Modesto, Calif.
Fisher, W. S., U. S. National Museum, Washington, D. C.
Flanders, S. E., Calif. Citrus Exp. Sta., Riverside, Calif.
Flebut, A. J., 15 Shattuck Sq., Berkeley, Calif.
Fleming, W. E., Box H, Moorestown, N. J.
†Fletcher, R. K., Box 152 Faculty Exchange, College Station, Texas.
†Fleury, A. C., c/o State Dept. of Agr., Sacramento, Calif.
†Flint, W. P., 1006 S. Orchard St., Urbana, Ill.
Fluke, C. L., University of Wisconsin, Madison, Wisc.
†Folsom, J. W., Tallulah, La.
Ford, A. L. Extension Division, Brookings, S. D.
Ford, M. H., 503 Rio Grande National Life Bldg., Harlingen, Texas.
Fox, Henry, Box H, Moorestown, N. J.
Fracker, S. B., 3716 Ingomar St., N. W., Washington, D. C.
Franklin, H. J., East Wareham, Mass.
†Freeborn, S. B., University of California, Davis, Calif.
Friend, R. B., Agr. Exp. Sta., New Haven, Conn.
†Frison, T. H., Dept. Ent., Natural History Bldg., Urbana, Ill.
†Frost, S. W., Research Lab., Arendtsville, Pa.
Fullaway, D. T., Agr. Exp. Station, Honolulu, H. T.
Fulton, B. B., N. C. State Col., Raleigh, N. C.

Gahm, O. E., 119 W. Dean St., West Chester, Pa.
Gaines, J. C., Jr., Dept. of Entomology, College Station, Texas.
Gaines, R. C., Tallulah, La.
Gambrell, F. L., Experiment Station, Geneva, N. Y.
Gardner, Theo. R., Box H, Moorestown, N. J.

†Members who attended 1931 meeting.

Garman, H., 638 So. Limestone St., Lexington, Ky.
Garman, Philip, Agr. Exp. Sta., New Haven, Conn.
Gentner, L. G., 1122 E. Main St., Medford, Ore.
Gibson, Arthur, Entomological Branch, Ottawa, Canada.
Gill, J. B., Box 444, Albany, Ga.
Gillette, C. P., Agr. Exp. Sta., Fort Collins, Colo.
Gilmore, J. U., Box 346, Clarksville, Tenn.
Ginsburg, J. M., Agr. Exp. Sta., New Brunswick, N. J.
Glasgow, Hugh, Agr. Exp. Sta., Geneva, N. Y.
Glasgow, R. D., Albany, N. Y.
†Glenn, P. A., Office of State Entomologist, Urbana, Ill.
†Goodwin, James C., Gainesville, Fla.
Goodwin, W. H., Box 5, North Lima, Ohio.
Graf, J. E., Bureau of Entomology, Washington, D. C.
Graham, S A., School of Forestry and Conservation, Univ. Michigan, Ann Arbor, Mich.
Granovsky, A. A., University Farm, St. Paul, Minn.
Gray, George P., 683 Chamber of Commerce Bldg., Los Angeles, Calif.
Gray, H. E., University Farm, St. Paul, Minn.
†Griswold, Grace Hall, Dept. Ent., Cornell Univ., Ithaca, N. Y.
Grossman, E. F., 546 W. 113th St., New York, N. Y.
Gui, H. L., Agr. Exp. Sta., Wooster, Ohio.
Guyton, F. E., 110 Miller Ave., Auburn, Ala.
Guyton, T. L., Bureau of Plant Industry, Harrisburg, Pa.

Haack, T. T., 174 E. Long St., Columbus, Ohio.
Haber, V. R., Penn. State College, State College, Pa.
Hadley, C. H., Box H, Moorestown, N .J.
Haegele, R. W., Parma, Idaho.
Haeussler, G. J., c/o American Consulate, Yokohama, Japan.
Hagan, H. R., Wahiawa via Honolulu, H. T.
†Haley, W. E., 8203 Oak St., New Orleans, La.
Hall, M. C., Division of Zoology, Bureau Animal Industry, Washington, D. C.
Hallock, H. C., Westbury, Long Island, N. Y.
Hamilton, C. C., Rutgers College, New Brunswick, N. J.
Hamlin, J. C., 473 Fourth Ave., Salt Lake City, Utah.
†Hamner, A. L., A. & M. College, Miss.
Hargraves, Ernest, Land & Forest Dept., Freetown, Sierra Leone, W. Africa.
Harman, S. W., Exp. Sta., Geneva, N. Y.
†*Harned, R. W., Bureau of Entomology, Washington, D. C.
†Harris, H. M., Zool. Dept., I. S. C., Ames, Iowa.
†Hartzell, Albert, Boyce Thompson Inst., 1086 No. Broadway, Yonkers, N. Y.
Hartzell, F. Z., Agr. Exp. Sta., Geneva, N. Y.
†Haseman, Leonard, Agr. Exp. Sta., Columbia, Mo.

---

†Members who attended 1931 meeting. *Life members.

Hawley, I. M., Box H., Jap. Beetle Lab., Moorestown, N. J.
Hayes, W. P., Dept. of Ent., University of Ill., Urbana, Ill.
†Headlee, T. J., Agr. Exp. Sta., New Brunswick, N. J.
Henderson, C. F., 222 6th Ave., E. Twin Falls, Idaho.
Henderson, W. W., Agr. Exp. Sta., Logan, Utah.
Herbert, F. B., Los Gatos, Calif.
†Herms, W B., Univ. of Calif., Berkeley, Calif.
Herrick, Glenn W., Cornell University, Ithaca, N. Y.
Hervey, G. E. R., Experiment Station, Geneva, N. Y.
†Hester, J. G., Box 597, Agricultural College, Miss.
†High, M. M., Box 989, Gulfport, Miss.
Hill, C. C., 227 Moreland Ave., Carlisle, Pa.
†Hinds, W. E., Louisiana State Univ., Baton Rouge, La.
Hobbs, Edward, Box 798, San Antonio, Texas.
Hodgkiss, H. E., Old Exp. Sta. Bldg., State College, Pa.
Hoerner, John L., Agr. Exp. Sta., Ft. Collins, Colo.
Hoffman, William A., School of Tropical Medicine, San Juan, P. R.
Hoffmann, W. E., Lignan University, Canton, China.
Holland, W. J., Carnegie Museum, Pittsburgh, Pa.
Holloway, J. K., Box H, Moorestown, N. J.
†Holloway, T. E., 8203 Oak St., New Orleans, La.
Hood, C. E., U. S. Bureau of Entomology, Melrose Highlands, Mass.
Hooker, W. A., States Relation Service, Washington, D. C.
Horsfall, J. L., 535 5th Ave., New York, N. Y.
Horton, J. R., 128 So. Minneapolis Ave., Wichita, Kansas.
†Hottes, Frederick C., 707 N. 7th St., Grand Junction, Colo.
Hough, W. S., 523 Fairmount Ave., Winchester, Va.
Houghton, C. O., Agr. Exp. Sta., Newark, Del.
†Houser, J. S., Agr. Exp. Sta., Wooster, Ohio.
Howard, L. O., U. S. Bureau of Entomology, Washington, D. C.
†Howard, Neale F., 151 West Eleventh Ave., Columbus, Ohio.
Howell, Peter A., U. S. D. A., Worden St., Springfield, Ohio.
Huber, L. L., Experiment Station, Wooster, Ohio.
Huckett, H. C., R. F. D., Calverton, N. Y.
Hungerford, H. B., Univ. Kansas, Lawrence, Kansas.
Hunter, S. J., Univ. Kansas, Lawrence, Kansas.
Hutson, J. C., Royal Botanic Gardens, Peradeniya, Ceylon.
†Hutson, Ray, State College, East Lansing, Mich.
Hyslop, J. A., U. S. Bureau of Entomology, Washington, D. C.

Illingworth, J. F., Bishop Museum, Honolulu, H. T.
Ingram, J. W., Houma, La.
Isley, Dwight, 3 N. Duncan St., Fayetteville, Ark.

Jacobson, W. C., 1341 43rd Street, Sacramento, Calif.

†Members who attended 1931 meeting.

Jaenicke, Alex. J., U. S. Forest Service, Portland, Ore.
†Jaynes, H. A., Casilla Correo, 307, Trujillo, Peru, S. A.
Jewett, H. H., Agr. Exp. Sta., Lexington, Ky.
Johannsen, O. A., Box 48, College of Agriculture, Ithaca, N. Y.
Johnson, J. Peter, Agr. Exp. Sta., New Haven, Conn.
Johnston, H. Bennett, Wellcome Lab., Khartum, Sudan.
Johnston, H. G., State College, Ames, Iowa.
Jones, C. R., Fort Collins, Colo.
Jones, Merlin P., Bur. Ent., Washington, D. C.
Jones, P. R., 8742 Clifton Way, Beverly Hills, Calif.
Jones, T. H., Melrose Highlands, Mass.

Keen, F. P., 501 Lewis Bldg., Portland, Oregon.
Keenan, W. N., Entomological Branch, Ottawa, Canada.
Kellogg, V. L., National Research Council, 21 and B Sts., Washington, D. C.
Kelly, E. G., Agricultural College, Manhattan, Kan.
Kelsheimer, E. G., Oak Harbor, Ohio.
Kennedy, C. H., Ohio State University, Columbus, Ohio.
Kimball, H. H., 801 Smith-Young Bldg., San Antonio, Texas.
Kincaid, Trevor, University of Washington, Seattle, Wash.
King, J. L., Box H, Moorestown, N. J.
King, K. M., Entomological Laboratory, Saskatoon, Sask., Canada.
King, W. V., Bureau of Science, Manila, P. I.
Kinsey, A. C., University of Indiana, Bloomington, Ind.
Kirk, H. B., 1902 North St., Harrisburg, Pa.
†Kislanko, J. P., Wiggins, Miss.
Kisliuk, Max, 134 S. 2nd St., Philadelphia, Pa.
Knight, H. H., Iowa State College, Ames, Iowa.
Knowlton, G. F., Utah Experiment Station, Logan, Utah.
Knull, J. N., Forest Research Institute, Mont Alto, Pa.

Laake, E. W., Box 208, Dallas, Texas.
Lammiman, John F., 201 Agr. Hall, Univ. Calif., Berkeley, Calif.
Lane, Merton C., Box 616, Walla Walla, Wash.
Langford, G. S., Univ. Md., College Park, Md.
Langston, J. M., Agricultural College, Miss.
Larrimer, W. H., U. S. Bureau of Entomology, Washington, D. C.
Larson, A. O., 337 N. 11th St., Corvallis, Ore.
†Lathrop, F. H., Box 167, Vincennes, Ind.
Lauderdale, J. L., Box 368, Yuma, Ariz.
Lawson, P. B., 635 Main St., Lawrence, Kansas.
†Leiby, R. W., Dept. of Agriculture, Raleigh, N. C.
†Leonard, M. D., Insular Exp. Sta., Rio Piedras, Porto Rico.
Lewis, H. C., Fruit Growers Exchange, Los Angeles, Calif.
Light, S. F., Dept. Zool., Univ. Calif., Berkeley, Calif.

†Members who attended 1931 meeting.

Lipp, J. W., 8316 Cadwalader Rd., Elkins Park, Pa.
List, G. M., Agricultural College, Fort Collins, Colo.
Little, V. A., Box 225, Main Bldg., College Station, Texas.
Lockwood, Stewart, State Dept. Agriculture, Sacramento, Calif.
Loftin, U. C., Central Baraguay, Prov. de Camaguey, Cuba.
Luginbill, Philip, Box 359, Monroe, Mich.
†Lyle, Clay, A. & M. College, Miss.

MacAloney, H. J., Northeast Forest Experiment Station, Amherst, Mass.
Mackie, D. B., Dept. Agr., Sacramento, Calif.
MacLeod, G. F., Roberts Hall, Cornell Univ., Ithaca, N. Y.
Maheux, George, Dept. Agr., Quebec, Canada.
Mail, Geo. Allen, Dept. Ent., Mont. Expt. Sta., Bozeman, Mont.
Manter, J. A., Connecticut Agr. College, Storrs, Conn.
†Marcovitch, S., University Farm, Knoxville, Tenn.
*Marlatt, C. L., U. S. Bureau of Entomology, Washington, D. C.
Marvin, Geo. E., 423 Dorset Ave., Chevy Chase, Washington, D. C.
Mason, A. C., Box 340, Honolulu, H. T.
Matheson, Robert, Cornell University, Ithaca, N. Y.
Mathewson, A. A., Box 1077, San Antonio, Texas.
Maxson, Asa G., Longmont, Colo.
McBride, O. C., Box 340, Honolulu, H. T.
McClendon, S. E., 212 South Hansell St., Thomasville, Ga.
McConnell, H. S., College Park, Maryland.
McDaniel, Eugenia, Agricultural College, East Lansing, Mich.
McDonough, F. L., Niagara Sprayer Co., Middleport, N. Y.
McGehee, T. F., Holly Springs, Miss.
McIndoo, N. E., 7225 Blair Rd., Takoma Park, Washington, D. C.
McIntyre, H. L., Conservation Commission, Albany, N. Y.
McKinney, K. B., Box 346, Clarksville, Tenn.
McLaine, L. S., Entomological Branch, Ottawa, Can.
McLean, R. R., County Bldg., San Diego, Calif.
McPhail, Miyanoato, Box 340, Honolulu, H. T.
†Melander, A. L., College of the City of New York, New York, N. Y.
Merrill, G. B., Gainesville, Fla.
Merrill, J. H., Raynham Center, Mass.
Metcalf, C. L., University of Illinois, Urbana, Ill.
Metcalf, Z. P., Agr. Exp. Station, West Raleigh, N. C.
Metzger, F. W., Box H, Moorestown, N. J.
Mickel, C. E., University Farm, St. Paul, Minn.
Millen, F. E., Department of Apiculture, Guelph, Canada.
Miller, D. F., Ohio State Univ., Columbus, Ohio.
†Miller, R. L., Box 491, Orlando, Florida.
Milum, V. G., 104 Vivarium Bldg., Champaign, Ill.

†Members who attended 1931 meeting. *Life members.

Mitchell, T. B., State College, Raleigh, N. C.
Mitchener, A. V., Manitoba Agr. College, Winnipeg, Canada.
†Montgomery, J. H., State Plant Board, Gainesville, Fla.
†Moore, William, c/o American Cyanamid Co., 511 5th Ave., New York, N. Y.
Morgan, H. A., Univ. of Tenn., Knoxville, Tenn.
†Morrill, A. W., 1505 Winchester Ave., Glendale, Calif.
Morrison, Harold, U. S. Bureau of Entomology, Washington, D. C.
Morse, A. P., Wellesley, Mass.
Mosher, Edna, Adelphi College, Garden City, N. Y.
Mote, D. C., Oregon Agr. College, Corvallis, Ore.
Moulton, Dudley, Director of Agriculture, Sacramento, Calif.
Moznette, G. F., Box 482, Albany, Ga.
Muesebeck, C. F. W., U. S. Nat. Museum, Washington, D. C.
Munro, J. A., State College, Fargo, N. D.

Neiswander, C. R., Oak Harbor, Ohio.
Neiswander, R. B., Ent. Dept., Experiment Station, Wooster, Ohio.
Nelson, J. A., Mt. Vernon, Ohio.
Ness, Henry, 821 Kellogg St., Ames, Iowa.
Neuls, J. D., 509 Acacia Ave., Whittier, Calif.
Newcomer, E. J., Box 243, Yakima, Wash.
†Newell, Wilmon, State Plant Commission, Gainesville, Fla.
Nichol, A. A., Agr. Exp. Station, Tucson, Ariz.
Nickels, C. B., Box 209, Brownwood, Texas.
Noble, W. B., Box 495, West Lafayette, Ind.
Nolan, Willis J., 507 Cumberland Ave., Chevy Chase Sta., Washington, D. C.
Nougaret, R. L., Mentone, Calif.

†O'Kane, W. C., Agr. Exp. Station, Durham, N. H.
†Osborn, Herbert, Ohio State Univ., Columbus, Ohio.
Osborn, Herbert T., 1952 Concord Rd., Columbus, Ohio.
Osborn, M. R., Box H, Moorestown, N. J.
Osburn, Raymond C., Ohio State University, Columbus, Ohio.
†Osgood, W. A., New Hampshire Univ., Durham, N. H.
Owen, W. H., Jr., Box 197, Presidio, Texas.
Ozburn, R. H., Department of Entomology, Guelph, Ont.

Packard, C. M., Box 495, West Lafayette, Ind.
Paddock, F. B., 535 Hayward Ave., Ames, Iowa.
Painter, H. R., Box 495, West Lafayette, Ind.
Painter, Reginald H., K. S. A. C., Manhattan, Kans.
Park, O. W., Science Bldg., Ames, Iowa.
Parker, H. L., Avenue Godillot, Hyeres, Var., France.
Parker, J. B., 1217 Lawrence St., N. E., Washington, D. C.
†Parker, J. R., Agr. Exp. Station, Bozeman, Montana.
†Parker, Ralph L., K. S. A. C., Manhattan, Kans.

†Members who attended 1931 meeting.

Parker, R. R., U. S. Public Health Service, Hamilton, Mont.
†Parker, Wm. B., Cal. Spray Chem. Co., 15 Shattuck Sq., Berkeley, Cal.
†Parks, H. B., Route 1, Box 368, San Antonio, Texas.
Parks T. H., Dept. of Ent. and Zool., Ohio State University, Columbus, Ohio.
Parman, D. C., Box 509, Uvalde, Texas.
Parrott, P. J., Agr. Exp. Station, Geneva, N. Y.
*Patch, Edith M., Experiment Station, Orono, Me.
Patch, L. H., Box 976, Sandusky, Ohio.
Peairs, L. M., Agr. Exp. Station, Morgantown, W. Va.
Pierson, H. B., Dept. Forestry, Augusta, Me.
Pellett, F. C., Hamilton, Ill.
Pemberton, C. E., Hawaiian Sugar Planters' Exp. Station, Honolulu, H. T.
Penny, D. D., Box 383, Ontario, Calif.
Pepper, J. O., 603 East King St., Chambersburg, Pa.
Peters, H. S., Bur. Ent., Washington, D. C.
Peterson, Alvah, O. S. U., Columbus, Ohio.
Pettit, R. H., Agr. Exp. Station, East Lansing, Mich.
Phillips, E. F., Cornell Univ., Ithaca, N. Y.
Phillips, W. J., Box 592, Charlottesville, Va.
Phipps, Clarence R., Experiment Station, Orono, Me.
Pierce, W. D., Biological Abstracts, Acad. Nat. Sciences, Philadelphia, Pa.
Plank, H. K., Trop. Plant Res. Foundation, 10th & G Sts., N.W., Washington,D.C.
Polivka, J. B., Oak Harbor, Ohio.
Poos, F. W., Arlington Farms, Rosslyn, Va.
Porter, B. A., Bureau of Entomology, Washington, D. C.
Potts, S. F., Bur. of Entomology, Melrose Highlands, Mass.
†Price, W. A., Agr. Exp. Sta., Lexington, Ky.

Quaintance, A. L., U. S. Bureau of Entomology, Washington, D. C.
Quayle, H. J., University of California, Riverside, Calif.

Rea, G. H., Reynoldsville, Pa.
Readio, Philip A., University of Kansas, Lawrence, Kansas.
†Reed, W. D., 200 Bland Rd., Richmond, Va.
Reese, C. A., Dept. Agr., Columbus, Ohio.
Reeves, George I., 473 4th Ave., Salt Lake City, Utah.
†Regan, W. S., Calif. Spray Chemical Co., Yakima, Wash.
Reid, W. J., U. S. Bureau of Entomology, Chadbourn, N. C.
Reinhard, H. J., Agr. Exp. Sta., College Station, Texas.
†Ressler, I. L., c/o Roessler Hasslacher Chem. Co., Niagara Falls, N. Y.
Richardson, C. H., Iowa State College, Ames, Ia.
Richmond, E. A., 39 Newbury St., Brockton, Mass.
Riley, Harland K., Dept. Ent., Purdue Univ. Expt. Sta., W. Lafayette, Ind.
Riley, W. A., University Farm, St. Paul, Minn.
Roark, R. C., U. S. Bur. Chem. and Soils, Washington, D. C.

†Members who attended 1931 meeting. *Life members.

†Robinson, J. M., Box 247, Exp. Sta., Auburn, Ala.
Robinson, R. H., Science Hall, Corvallis, Ore.
Robinson, Wm., 2401 Calvert St. N. W., Washington, D. C.
Rockwood, L. P., Bur. Ent., Forest Grove, Ore.
Rohwer, S. A., Bur. Ent., Washington, D. C.
†Rosewall, O. W., State Univ., Baton Rouge, La.
Ross, W. A., Vineland Station, Ontario, Canada.
Rude, C. S., Tlahualilo, Durango, Mexico.
Ruffin, W. A., Box 247, Auburn, Ala.
†Ruggles, A. G., University Farm, St. Paul, Minn.
Rumsey, W. E., Agr. Exp. Station, Morgantown, W. Va.
Runner, G. A., U. S. Ent. Lab., Sandusky, Ohio.
Ryan, H J., 330 No. Broadway, Los Angeles, Calif.

Safro, V. I., c/o Kay Lab., Inc., 180 Madison Ave., New York, N. Y.
Sanders, G. E., c/o Ansbacher Chemical Co., 50 Union Sq., New York, N. Y.
Sanders, J. G., c/o Sun Oil Co., Philadelphia, Pa.
†Sanders, P. D., Bureau Ent., Washington, D. C.
Sanderson, E. D., Cornell University, Ithaca, N. Y.
Sanford, H. L., Plant Quarantine and Control Admin., Washington, D. C.
Sasscer, E. R., Plant Quarantine and Control Admin., Washington, D. C.
†Satterthwait, A. F., 527 Ivanhoe Place, Webster Groves, Mo.
Sazama, Robert F., Entomological Lab., Vincennes, Ind.
Scammell, H. B., Toms River, N. J.
Schaffner, J. V., Jr., Melrose Highlands, Mass.
†Schlosberg, Morris, 615 Front St., Toledo, Ohio.
Schoene, W. J., Agr. Exp. Station, Blacksburg, Va.
†Schweiss, G. G., State Quarantine Office, Reno, Nevada.
Scullen, H. A., Agr. College, Corvallis, Ore.
Seamans, H. L., Ent. Lab., Lethbridge, Alberta, Canada.
†Searls, E. M., 1532 Univ. Ave., Madison, Wisc.
Sechrist, Edw. L., Bee Culture Field Sta., Davis, Calif.
Severin, H. C., Agricultural Experiment Station, Brookings, S. D.
Severin, H. H., College of Agr., Univ. of Calif., Berkeley, Calif.
Shafer, G. D., 321 Melville Ave., Palo Alto, Calif.
Shelford, V. E., Vivarium Bldg., Univ. of Illinois, Champaign, Ill.
Sheppard, R. W., P. O. Box 35, Niagara Falls, Ont., Canada.
Sherman, Franklin, Dept. of Entomology, Clemson College, S. C.
Sherman, III, Franklin, Dept. Ent., M. A. C., E. Lansing, Mich.
Shirck, F. H., Box 237, Parma, Idaho.
Shotwell, R. L., 801-6th Ave., So. Bozeman, Mont.
Siegler, E. H., U. S. Bureau of Entomology, Washington, D. C.
Simanton, F. L., Drawer 359, Monroe, Mich.
Simmons, Perez, 712 Elizabeth Street, Fresno, Calif.
Sleesman, J. P., O. Agr. Exp. Sta., Wooster, Ohio.
†Smith, Charles E., Exp. Sta., Baton Rouge, La.

†Members who attended 1931 meeting.

Smith, Floyd F., Bur. Ent., Washington, D. C.
Smith, G. L., Delta Lab., Tallulah, La.
Smith, Herbert, D., Le Mont Fenouillet, Hyeres, Var. France.
Smith, H. S., Citrus Experiment Station, Riverside, Calif.
Smith, L. B., Dix. Extension, Pa. State College, State College, Pa.
Smith, Marion R., State Plant Bd., A. & M. College, Miss.
†Smith, Roger C., Agl. College, Manhattan, Kans.
Smith, R. H., Citrus Exp. Sta., Riverside, Calif.
Smulyan, Marcus T., Melrose Highlands, Mass.
*Smyth, E. Graywood, Hacienda Cartavio Salaverry, Peru.
†Snapp, O. I., Bureau of Entomology, Fort Valley, Ga.
Snow, S. J., 473 4th Ave., Salt Lake City, Utah.
Snyder, T. E., U. S. Bureau of Entomology, Washington, D. C.
†Sorenson, Charles J., Experiment Station, Logan, Utah.
Spencer, Geo. J., Dept. Zoology, Univ. of B. C., Vancouver, B. C., Canada.
Spencer, Herbert, Box 482, Albany, Ga.
Spruijt, F. J., Box 786, Babylon, Long Island, N. Y.
Spuler, Anthony, Agricultural Exp. Station, Wenatchee, Wash.
Stafford, E. W., Agricultural College, Miss.
Stahl, C. F., Box 549, Sanford, Fla.
Stear, Jacob R., Koppers Expt. Farm, Ligonier, Pa.
†Stearns, L. A., Univer. of Del., Newark, Delaware.
†Steiner, L. F., Cornelia, Ga.
Stene, A. E., Kingston, R. I.
St. George, R. A., Entomological Lab., E. Falls Church, Va.
Stirrett, G. M., Ent. Laboratory, Chatham, Ontario, Canada.
Stockwell, C. W., U. S. D. A., 22 Elizabeth St., S. Norwalk, Conn.
Stone, Wm. E., Calzada Tacuba 153, Colonia Anahuae, Mexico.
Strand, A. L., Dept. Ent., State College, Bozeman, Mont.
Strickland, E. H., University of Alberta, Edmonton, Canada.
Strong, Lee A., Plant Quarantine and Control Adm., Washington, D. C.
†Sullivan, K. C., Board of Agriculture, Jefferson City, Mo.
Summers, John N., Greenfield, Mass.
Swain, A. F., Box 428, El Monte, Calif.
Swain, J. M., Ent. Branch, Ottawa, Canada.
Sweetman, Harvey L., M. S. C., Amherst, Mass.
Swenk, M. H., 1410 No. 37th St., Lincoln, Neb.
Swezey, O. H., Hawaiian Sugar Planters' Exp. Station, Honolulu, H. T.
Swingle, H. S., Box 247, Auburn, Ala.
Symons, T. B., Agr. Exp. Station, College Park, Md.

†Tanquary, M. C., Univ. Farm, St. Paul, Minn.
Taylor, R. L., Dept. Biology, College William and Mary, Williamsburg, Va.
Tenhet, Joseph N., Fairfax, N. C.
Thomas, C. A., Kennett Sq., Pa.

†Members who attended 1931 meeting. *Life members.

†Thomas, F. L., College Station, Texas.
Thomas, W. A., Chadbourne, N. C.
Thompson, B. G., 303 Agriculture Hall, Corvallis, Ore.
Timberlake, P. H.., Citrus Exp. Station, Riverside, Calif.
Tissot, Archie N., Dept. Zool. and Ent., O. S. U., Columbus, Ohio.
Titus, E. G., 1080 S. 5th Ave., Salt Lake City, Utah.
Todd, Frank E., Bee Culture Field Sta., Davis, Calif.
Todd, J. N., Box 798, San Antonio, Texas.
Trimble, F. M., Camp Hill, Pa.
Troop, James, Agricultural Exp. Station, Lafayette, Ind.
Turner, Neely, Experiment Station, New Haven, Conn.
Turner, W. F., U. S. Peach Disease Lab., Fort Valley, Ga.

Underhill, G. W., Route 4, Box 101 A., Richmond, Va.

Vance, Arlo M., 10 Court St., Arlington, Mass.
Van Dine, D. L., Central Baragua, Baragua Camagney, Province, Cuba.
Van Duzee, E. P., Academy Sciences, San Francisco, Calif.
Van Dyke, E. C., University of California, Berkeley, Calif.
Van Leeuwen, E. R., Box H, Moorestown, N. J.
Vansell, G. H., University Farm, Branch Coll. of Agriculture, Davis, Calif.
Van Zwaluwenberg, R. H., H. S. P. A., Experiment Station, Honolulu, H. T.
Vickery, R. A., Box 884, San Antonio, Texas.
Vorhies, Chas. T., Univ. Station, Tucson, Ariz.

Wade, J. S., U. S. Bureau of Entomology, Washington, D. C.
Wadley, F. M., Bureau of Entomology, Washington, D. C.
Wakeland, C. C., Moscow, Idaho.
Walden, B. H., Agricultural Exp. Station, New Haven, Conn.
Walkden, H. H., 128 S. Minneapolis Ave., Wichita, Kansas.
Walker, Harry G., Truck Expt. Sta., Norfolk, Va.
Wallace, F. N., 132 State House, Indianapolis, Ind.
†Walter, E. V., U. S. Entomological Lab., San Antonio, Tex.
Walton, W. R., U. S. Bureau of Entomology, Washington, D. C.
Wardle, R. A., Univ. of Manitoba, Winnipeg, Canada.
Webb, J. L., U. S. Bureau of Entomology, Washington, D. C.
Webber, R. T., U. S. Bureau of Entomology, Melrose Highlands, Mass.
Webster, R. L., State College, Pullman, Wash.
†Weed, Alfred, 114 E. 32nd St., New York, N. Y.
Wehrle, L. P., 117 Olive Road, Tucson, Ariz.
Weigel, C. A., Bur. Ent., Washington, D. C.
Weiss, H. B., 19 N. 7th Ave., Highland Park, New Brunswick, N. J.
Weldon, G. P., 420 East D. Street, Ontario, Calif.
Wellhouse, Walter, Iowa Agricultural College, Ames, Iowa.
Wells, Roscoe W., 1162 E. Main St., Galesburg, Ill.
Wheeler, W. M., Mus. of Comp. Zool., Cambridge, Mass.

†Members who attended 1931 meeting.

Whelan, Don B., Dept. Ent., Univ. Nebraska, Lincoln, Nebr.
Whitcomb, W. D., 82 Plympton St., Waltham, Mass.
Whitehead, F. E., A. & M. College, Stillwater, Oklahoma.
Wilcox, Joseph, Experiment Station, Corvallis, Oregon.
Wildermuth, V. L., Entomological Laboratory, Tempe, Ariz.
Willard, H. F., Box 340, Honolulu, H. T.
Williams, C. B., 29 Queens Crescent. Edinburgh, Scotland.
Wilson, C. C., 600 26th St., Sacramento, Calif.
Wilson, H. F., 1532 University Ave., Madison, Wis.
†Winter, J. D., University Farm, St. Paul, Minn.
Woglum, R. S., Calif. Fruit Growers' Exchange, Los Angeles, Calif.
*Wolcott, G. N., Isabela Sub Sta., Isabela, P. R.
Wood, W. B., P. Q. C. A., Washington, D. C.
Woods, W. C., Kent School, Kent, Conn.
Worthley, Harlan N., Old Exp. Sta. Bldg., State College, Pa.
Worthley, L. H., 22 Elizabeth St., S. Norwalk, Conn.
Wymore, Floyd H., Univ. Farm, Davis, Calif.

†Yeomans, Manning S., 332 State Capitol, Atlanta, Ga.
Yetter, Wm. P., Jr., Box 167, Vincennes, Ind.
Yothers, M. A., Box 1403, Wenatchee, Wash.
†Yothers, W. W., Box 491, Orlando, Fla.
Young, Martin T., Tallulah, La.
Yuasa, Hachiro, Institute of Ent., Kyoto Imperial Univ., Kyoto, Japan.

Zappe, Max P., Expt. St., New Haven, Conn.
Zetek, James, Drawer Z., Balboa, Canal Zone, Panama.
Total number of active members, 621.

ASSOCIATE MEMBERS

†Aamodt, T. L., University Farm, St. Paul, Minn.
Adams, J. Alfred, State College, Ames, Iowa.
†Allen, Norman, Exp. Sta., Baton Rouge, La.
Allen, Thos. C., Dept. Ent., Univ. Wisc., Madison, Wisc.
Amis, Albert H., Apartado 36, Los Mochis, Sinaloa, Mexico.
Anthony, M. V., R. F. D. 4, Louisville, Ohio.
Arbuthnot, K. D., Drawer 359, Monroe, Mich.
Arnold, R. B., c/o Tobacco By-Prod. & Chem. Corp., Richmond, Va.
Ashworth, John T., Danielson, Conn.
Audant, André, Service Technique, Port au Prince, Haiti.
Avery, Paul C., Mission, Texas.

Badertcher, A. E., 50 College Ave., New Brunswick, N. J.
Bailey, I. L., Northboro, Mass.

†Members who attended 1931 meeting. *Life members.

Bailey, John W., Richmond University, Richmond, Va.
Bailey, Stanley F., Box 297, Alhambra, Calif.
Baker, Wm. W., Box 233, Puyallup, Wash.
Ballou, Charles H., Apartado 1368, San José, Costa Rica.
Balzer, August I., Agr. Sub. Station 4, Beaumont, Texas.
Bare, C. O., Box 1525, Sanford, Fla.
Bare, O. S., 1535 N. 32nd St., Lincoln, Neb.
Barnes, O. L., Entomological Lab., Tempe, Arizona.
Barnes, P. T., 908 Highland Ave., Palmyra, N. J.
Barrett, R. E., Box 171, Saticoy, Calif.
Bartlett, Irene L., Div. of Insects, National Museum, Washington, D. C.
Bartlett, Kenneth A., 10 Court St., Arlington, Mass.
Baumgartner, M. H., Apto 62, Ciudad Obregon, Sonora, Mexico.
Beal, J. A., 501 Lewis Bldg., Portland, Oreg.
Becton, E. M., 707 Washington Ave., Palmyra, N. J.
Bedard, Wm. D., Forest Insect Field Sta., Couer d'Alene, Idaho.
†Benton, Curtis, Box 495, U. S. Ent. Lab., W. Lafayette, Ind.
Berry, Palul A., 1156 Main St., Melrose Hlds., Mass.
Beutenmuler, Wm., 85 Elm St., Tenafly, N. J.
Biederdorf, G. A., Dept. Ent., A. & M. College, Stillwater, Okla.
Billings, Samuel C., R. D. 1, Silver Spring, Md.
Birkett, T. E., 106 Whitten Hall, Columbia, Mo.
Bissell, Theo. L., Experiment, Ga.
Blaisdell, H. L., 20 Sanderson St., Greenfield, Mass.
Blauvelt, William E., 214 Thurston Ave., Ithaca, N. Y.
Bogue, Robert, 3860 Seneca Ave., Los Angeles, Calif.
Boillot, Buell F., 110 Capitol Bldg., Jefferson City, Mo.
†Bond, G. L., P. O. Box 297, Laurel, Miss.
Botsford, Robert C., Agr. Expt. Sta., New Haven, Conn.
Bottger, Gilbert T., Drawer 359, Monroe, Mich.
Bowen, Myles F., Spanish Fork, Utah.
Brigham, William Theodore, 77 Elizabeth St., New Haven, Conn.
Brindley, Tom A., Box 73, Moscow, Idaho.
Bronson, Theodore E., 229 Clifford Ct., Madison, Wisc.
Broome, Jr., G. C., 1532 University Ave., Madison, Wisc.
Brower, A. E., 13 Newton Way, Bar Harbor, Me.
Brown, J. G., c/o Sun-Maid-Raisin-Growers, Plant 6, Fresno, Calif.
Brown, Raymond C., Bur. Ent., Melrose Highlands, Mass.
Browne, Ashley C., Dept. Agr., State Office Bldg., Sacramento, Cal.
Brubaker, Ross W., 151 W. 11th Ave., Columbus, Ohio.
Bruce, Wesley G., Dept. Ent., K. S. A. C., Manhattan, Kans.
Brummitt, Sidney C., Grand Bay, Ala.
†Brunson, M., Box 415, Picayune, Miss.
Brunson, Marvin H., Box H., Moorestown, N. J.
Buchanan, Dwight, University Farm, St. Paul, Minn.
Buck, J. E., Prosperity, S. C.
Bunn, Ralph, 473-4th Ave., Salt Lake City, Utah.

†Members who attended 1931 meeting.

Burgess, Emory D., 10 Court St., Arlington, Mass.
Burtch, Lewis A., Room 204, Bakersfield, Calif.
Bushnell, Ralph J., 1724 Regent St., Madison, Wisc.
Butcher, F. Gray, Dept. Ent., Cornell Univ., Ithaca, N. Y.

Caldwell, E. G., Foley, Ala.
†Calhoun, S. L., Box 353, Presidio, Texas.
Call, A. B., Box 254, Provo, Utah.
Callenbach, Jr., John A., 803 State St., Madison, Wisc.
Campbell, Cyril F., Bureau Plant Industry, Harrisburg, Pa.
Campbell, L. W., 79 New Montgomery St., San Francisco, Calif.
Cannon, E. W., c/o Calif. Spray Chemical Corp., San Jose, Calif.
†Carpenter, H. H., State Plant Board, Houston, Miss.
Carpenter, S. J., Univ. of Tenn., Knoxville, Tenn.
Carrol, Francis E., 1915 W. Lawn Ave., Madison, Wisc.
Carroll, Mitchell, F. & M. College, Lancaster, Pa.
Carruth, Lawrence A., Dept. Ent., Cornell Univ., Ithaca, N. Y.
Carter, Roscoe H., Bur. Chem. & Soils, Washington, D. C.
Cavitt, Hugh S., Alpine, Texas.
Chamberlin, Joseph C., Box 1100, Twin Falls, Idaho.
Childs, Edwin R., 1201 S. Broadway, Santa Ana, Calif.
Chistenson, L. D., Central Baragua, Prov. Camaguey, Cuba.
Clapp, S. C., Mountain Branch Station, Swannanoa, N. C.
Clarke, C. A., American Consulate, Kobe, Japan.
Clarke, Wm. H., Exp. Station, Thomaston, Ga.
Clement, Robert L., 60 N. Sycamon St., West Hempstead, L. I., N. Y.
Clifton, H. K., New Holland, Ohio.
Cody, L. R., Hall of Justice, San Jose, Calif.
Coffin, Owen T., c/o Leffingwell Ranch, Box 218, Whittier, Calif.
Cole, Arthur C., Jr., O. S. U., Columbus, Ohio.
Colman, Wallace, Box 241, Silver Spring, Md.
†Colmer, Robert P., Moss Point, Miss.
†Conklin, James G., Durham, N. H.
Conn, Syrus, Tallulah, La.
†Cooper, James F., Box 167, Vincennes, Ind.
Couch, Oscar E., Jefferson City, Tenn.
Cox, J. A., Agr. Exp. Station, Geneva, N. Y.
Craig, F. W., 1634 Franklin Ave., Charleston, W. Va.
Crane, H. A., Box 935, Marysville, Calif.
Crawford, A. W., Agr. Exp. Sta., Geneva, N. Y.
Cressman, Albert W., Box 7, Station G., New Orleans, La.
Crooks, Clarence A., Box 976, Sandusky, Ohio.
Crowley, D. J., Long Beach, Wash.
Culbertson, Raymond E., Lempeter, Pa.
Curl, Chester L., 489 N. Center St., Orange, Calif.
Curl, L. F., Marfa, Texas.

†Members who attended 1931 meeting.

Daines, Jr., Robert H., E. 5 North, Logan, Utah.
Darley, Merrill M., Dept. Ent. O. S. U., Columbus, Ohio.
†Davidson, Ralph H., Dept. Ent., O. S. U., Columbus, Ohio.
Davis, E. G., U. S. Ent., Lab., Tempe, Ariz.
Davis, I. W., Danielson, Conn.
Davis, L. Reid, State College, Ames, Iowa.
Davis, Louis G., 630 S. Whitcomb St., Fort Collins, Colo.
Dawsey, Lynn H., Box 7, Sta. G., New Orleans, La.
Dawson, J. Carl, Bd. Agr., Jefferson City, Mo.
Dean, F. P., Bur. Ent., Yakima, Wash.
Dean, Ralph W., Dept., Entmology, O. S. U., Columbus, Ohio.
Dearborn, F. E., 216-13th St., S. W., Washington, D. C.
†De Coursey, J. Don., 208 W. Nevada Ave., Urbana, Ill.
†Deen, O. T., Box 205, Biloxi, Miss.
†Deen, R. B., Tupelo, Miss.
Denberry, E. P., Greenfield, Tenn.
Denny, Charles, 119 Capitol Bldg., Jefferson City, Mo.
Dibble, C. B., Ent. Dept., State College, East Lansing, Mich.
Dicke, F. F., Box 592, Charlottesville, Va.
Dills, L. E., State College, Pa., (Expt. Sta. Bldg.)
Dimick, Roland E., Agr. Bldg., Corvallis, Ore.
Dirks, C. O., Div. of Entomology, Univ. of Me., Orono, Me.
Ditman, L. P., Univ. of Maryland, College Park, Md.
Dixon, J. W., Independence, Calif.
Dobbins, Traber N., Bay Springs, Miss.
Donohoe, Huber C., 712 Elizabeth St., Fresno, Calif.
Dorst, H. E., 925 Indiana, Lawrence, Kansas.
Dorward, Kelvin, 106 Morrill Hall, Knoxville, Tenn.
†Douglass, N. L., Box 613, Grenada, Miss.
Douglas, W. A., Box 164, Crowley, La.
Douglass, Wm. J., Box 94, Naco, Ariz.
Dove, Walter H., Cia Carbonifera de Sabinas, S. A. Rosita, Coahuila. Mexico.
Drinnan, D. E., Route 1, Cumberland Gap, Tenn.
Drumheller, C. E., Buena Vista, Ohio.
Duggan, C. E., Box 445, San Dimas, Calif.
Durham, Wallace, 2412 E. 57th St., Los Angeles, Calif.
Dutton, W. C., M. S. C., Dept. Hort., E. Lansing, Mich.
Dye, H. W., Niagara Sprayer Co., Middleport, N. Y.

Ebeling, Walter, 551 S. Resh St., Anaheim, Calif.
Eddy, M. W., 249 W. Louther St., Carlisle, Pa.
Ellenwood, W. W., Dept. Agr., Columbus, Ohio.
Emery, W. T., 1285 Minneapolis Ave., Wichita, Kansas.
Esselbaugh, Chas. O., 723 Walnut St., Fostoria, Ohio.
Evans, John Harwood, Oshkosh High School, Oshkosh, Wisc.
Everly, Ray T., 425 Fourth St., Toledo, Ohio.

---

†Members who attended 1931 meeting.

Fahey, Jack E., Box 1414, Wenatchee, Wash.
Fall, F. L., 313 Montauk Ave., New London, Conn.
Farleman, M. G., 213 Ann St., Box 753, E. Lansing, Mich.
Farlinger, D. F., Cornelia, Ga.
Farmer, Lowell J., Moscow, Idaho.
Farrar, Clayton L., U. S. Bee Culture Field Sta., Laramie, Wyo.
Farrer, Edward R., South Lincoln, Mass.
Fattig, P. W., Box 788, Emory University, Ga.
Fey, K. Y., East Hill, Sia-Shih, Checkiang, China.
Filmer, R. S., Rutgers Univ., New Brunswick, N. J.
Fletcher, Fred W., N. Y. State College of Forestry, Syracuse, N. Y.
Fox, Robert H., 2312 Shayer Rd., Dayton, Ohio.
Franke, L. J., El Campo, Texas.
Frankenfield, J. C., U. S. Ent. Lab., Tempe, Arizona.
†Frazier, J. M., Sta. A, Box 156, Hattiesburg, Miss.
Freeman, W. H., 314-79th St., Brooklyn, N. Y.
French, G. T., State Office Bldg., Richmond, Va.
Frost, L. A., Thayer International Bridge, Mercedes, Texas.
Fulton, R. A., Box 1100, Twin Falls, Idaho.

Garrettson, Geo. W., 702 Meridian Ave., So. Pasadena, Calif.
Gates, Leroy M., R. F. D. No. 6, Lincoln, Nebraska.
Gay, G., 7 Custom House Bldg., Charleston, S. C.
Geissler, Geo. H., 34 Swan St., Lawrence, Mass.
Getzender, C. W., Box 233, Puyallup, Wash.
Gibson, L. E., Greenfield, Mass.
Gilbertson, G. J., State College, Brookings, S. D.
Gillespie, D. G., Hood River Exp. Sta., Hood River, Ore.
Gillette, Claude C., North Rose, N. Y.
†Girardeau, J. H., McRae, Ga.
Gjullin, C. M., Box 1062, Portland, Oregon.
Glance, Grace E., Bur. of Entomology, Washington, D. C.
†Glover, L. C., Theta U. House, Durham, N. H.
Gnadinger, C. B., 4941 Upton Ave., So. Minneapolis, Minn.
†Good, Newell E., 2000 H. St., N. W., Washington, D. C.
Goodgame, L. J., Box 222, Aberdeen, Miss.
Goseco, Frederico P., c/o LaCarlotta Sugar, Central LaCarlotta, P. I.
Gould, Geo. E., Agr. Expt. Sta., Lafayette, Ind.
Grady, A. G., Sinclair Refining Co., E. Chicago, Ind.
Grady, H. J., 204 Franklin St., New York, N. Y.
Graham, C., College Park, Md.
Gram, Ernest, Statens Plantspatologiske, Lyngby, Denmark.
Grant, D. H., R. F. D. No. 1, Scotch Plains, N. J.
Grant, Wilbur R., State College, Ames, Iowa.
Gray, John, Box H., Moorestown, N. J.
Gray, Kenneth, 210 N. 16 St., Corvallis, Ore.
†Gray, W. L., Box 433, Natchez, Miss.

†Members who attended 1931 meeting.

Green, C. E., Limoneira Ranch, Santa Paula, Calif.
Green, E. C., 1101 W. Green St., Urbana, Ill.
Green, G. D., Ent. Dept., State College, Bozeman, Mont.
Gregory, F. W., Federal Bldg., Niagara Falls, Canada.
Griffin, E. L., Food, Drug and Insecticide Admin., Washington, D. C.
Griffith, C. H., University Farm, St. Paul, Minn.
†Grimes, D. W., Box 125, Durant, Miss.
Gross, Cecil R., Bur. Chem. & Soils, Washington, D. C.
Grout, Roy A., Hamilton, Ill.
Gunderson, A. J., c/o Sherwin-Williams Co., Cleveland, Ohio.
Guthrie, H. E., 2644 Lincolnway, Ames, Iowa.
Gwin, C. M., 308 N. Blount St., Madison, Wisc.
Gwinner, Charles C., 6300 State Road, Philadelphia, Pa.

†Haas, Louise E., Iowa State College, Ames, Iowa.
Haasis, F. A., Dept. Plant Pathology, Cornell Univ., Ithaca, N. Y.
Haden, Wm. R., 329 Chittenden Ave., Columbus, Ohio.
Haines, Kenneth A., Dept. Ent., O. S. U., Columbus, Ohio.
Hall, Ralph C., Forest Exp. Station, O. S. U., Columbus, Ohio.
Hambleton, E. J., Escola de Agricultura, Vicosa Minas Geraes, Brazil.
Hamilton, D. W., Lyndon, Ill.
Hammer, Oscar H., Dept. Ent., Cornell Univ., Ithaca, N. Y.
Hanson, Arthur J., W. Wash. Exp. Sta., Puyallup, Wash.
Harris, F. H., O. S. U., Biol. & Zool. Bldg., Columbus, Ohio.
†Harris, J. A., N. C. Dept. Agr., Raleigh, N. C.
†Harrison, P. K., Exp. Station, Baton Rouge, La.
Hartnack, Hugo, 608 S. Dearborn St., Box 5, Chicago, Ill.
Hatcher, R. F., 107 Lee St., Winchester, Va.
Hatten, M. J., Brookings, S. D.
Haug, Gordon W., Dept. Ent., O. S. U., Columbus, Ohio.
Hawkins, J. H., Dept. Ent., Cornell Univ., Ithaca, N. Y.
Heming, W. E., Ont. Agr. College, Guelph, Ont., Canada.
Hensill, Geo. S., Room 201 Agr. Hall, Univ. of Cal., Berkeley, Calif.
Hering, Paul E., Dept. Ent., Cornell Univ., Ithaca, N. Y.
Herr, E. A., Corn Borer Lab., Oak Harbor, Ohio.
Hertzog, P. H., Hightstown, N. J.
†Hill, Sam O., 10 Court St., Arlington, Mass.
Hills, O. A., Box 173, Hermiston, Oregon.
Hines, Chesley, Yazoo City, Miss.
Hinman, Frank G., 140 N. 25th St., Corvallis, Ore.
Hinnenkamp, Frieda B., Box 1100, Twin Falls, Idaho.
Hixson, Homer, 2522 Chamberlain St., Ames, Iowa.
†Hockenyos, Geo. L., 1003 Oregon St., W. Urbana, Ill.
Hodson, Alexander C., Zool. Dept., Univ. Minn., Minneapolis, Minn.
Hodgson, B. E., 10 Court St., Arlington, Mass.
Hoffman, Clarence H., Div. Ent., Univ. Farm, St. Paul, Minn.
Hoidale, P. A., 503 Rio Grande, National Life Bldg., Harlingen, Texas.

†Members who attended 1931 meeting.

Holbrook, J. E. R., Melrose Highlands, Mass.
Holdridge, Abby, 1700 L. St., N. W., Washington, D. C.
Hollingsworth, H. S., 1745 Anderson St., Manhattan, Kans.
†Hollingsworth, W. B., Picayune, Miss.
Hollister, W. O., c/o Davey Tree Experts, Kent, Ohio.
Hookum, Don W., Univ. Maryland, College Park, Md.
Hopkins, C. O., State University, Baton Rouge, La.
Hopkins, F. G., 406 Morrill Hall, Knoxville, Tenn.
Horsfall, Wm. R., Dept. Ent., Cornell Univ., Ithaca, N. Y.
Horton, George, Box 5215 State College Sta., Raleigh, N. C.
Horton, Harvey A., Carnegie, Okla.
Hoskins, William M., 111 Agr. Hall, Univ. of Calif., Berkeley, Cal.
Hoyt, Avery S., P. Q. C. A., Dept. Agr., Washington, D. C.
Hudson, G. H., Plattsburg, N. Y.
Hull, Frank M., 1104 University St., Univ. of Miss., Univ. Miss.
Hunt, Ronald W., Box 62, Whittier, Calif.
Hunt, William T., P. O. Box 997, El Paso, Texas.
Hutchison, Robert N., 225 Italia St., Covina, Calif.

Irish, C. F., 418 E. 105th St., Cleveland, Ohio.
Irvin, F. V., Box 1355, Phoenix, Ariz.

Jameson, John H., 125 Norway Rd., Bangor, Me.
Janes, Melvin, Ent. Dept., State College, Logan, Utah.
Jenkins, Lee, 320 W. Myrtle St., Ft. Collins, Colo.
Johnson, A. C., 612 Mills Bldg., El Paso, Texas.
Johnson, Paul H., Dept. Ent., Columbia, Mo.
Johnson, Philip C., 341 Giannini Hall, Univ. of Calif., Berkeley, Calif.
Johnston, Harmon R., Box 5215, State Coll. Sta., Raleigh, N. C.
Jones, Elmer T., 128 S. Minneapolis Ave., Wichita, Kans.
Jones, E. W., Box 616, Walla Walla, Washington.
Jones, G. D., 106 Whitten Hall, Columbia, Mo.
Jones, Howard A., Bur. Chemistry & Soils, Washington, D. C.
Jones, Leland J., 435 University St., Salt Lake City, Utah.
Jones, R. M., Fruit Exp. Station, Mountain Grove, Mo.
Jones, Sloan E., College Station, Texas.
Jones, Sidney C., State College, Corvallis, Ore.
Jones, Victor E., University of Idaho, Pocatello, Idaho.
Jones, W. W., 1300-10th St., Douglas, Ariz.
Jorgensen, Drew D., Box 1117, Phoenix, Ariz.
Jung, Goey Park, Bur. Ent., Nanking, China.

Kagy, J. Franklin, State College, Ames, Iowa.
Kamal, Mohammed, Cotton Research Board, Giza, Egypt.
Kearns, Clyde W., Univ. Ill., Urbana, Ill.
Keck, Chester B., Box 340, Honolulu, H. T.
Kegley, Fred W., 406 Morrill Hall, Knoxville, Tenn.

†Members who attended 1931 meeting.

Keler, Stefan, Pantswowy Institute, Nankowo-Rolniczy, Bydgoszaz, Poland.
Kelley, R. W., Box 1959, Orlando, Fla.
Kellogg, C. R., Mass. State College, Amherst, Mass.
Kelly, Sam G., 1600 Houston St., Manhattan, Kansas.
Kennedy, R. D., 7 Graceland Ave., Staten Island, N. Y.
Kent, Virgil F., 308 W. Elm St., Monroe, Mich.
Kidder, Nathaniel T., Milton, Mass.
†Kile, Henry J., 1113 Holly St., Nashville, Tenn.
Kinsley, Chas. H., 1089 C. St., Sacramento, Cal.
Kirkpatrick, Albert F., R. D. 1, Box 475, Monrovia, Cal.
Knight, Hugh, Box 382, Upland, Calif.
Knight, Paul, College Park, Maryland.
Knipling, Edward F., Box 2080, Dallas, Texas.
Koch, K. L., Univ. of Wis., Madison, Wis.
Kohle, G. M., Hamilton, Montana.
Kraus, E. J., Univ. of Chicago, Chicago, Ill.

Lacroix, D. S., 24 Prospect St., Amherst, Mass.
LaFollette, J. R., 329 Alta Ave., Whittier, Calif.
Lanchester, Horace P., Parma, Idaho.
†Landis, Birely J., 151 W. 11th Ave., Columbus, Ohio.
Landon, W. E., R. F. D., San Dimas, Calif.
Latta, Randall, Box 566, Sumner, Washington.
Lebert, Carol D., Box 2008, Phoenix, Ariz.
Ledyard, E. M., c/o U. S. Smelting Co., Salt Lake City, Utah.
Lehman, Russell S., Box 616, Walla Walla, Wash.
Lewis, C. W., 408 Atlantic Ave., Boston, Mass.
Lilly, John H., 1532 Univ. Ave., Madison, Wisc.
Lindgren, David L., University Farm, St. Paul, Minn.
Ling, Setek, 188 Juan Luna, Manila, P. I.
Liston, B. E., 925 Indiana St., Lawrence, Kansas.
Liu, Chung Lo, Tsing Hua College, Peking, China.
Livingstone, Erskine M., 200 Bland St., Richmond, Va.
Lobdell, R. N. Mrs., Everglades Exp. Sta., Belle Glade, Fla.
Loding, C. P., 166 Houston St., Mobile, Ala.
Longan, E. W., State Office Bldg., Sacramento, Calif.
Lopez, A. W., Box 27 La Carlota, Occidental Negros, P. I.
Lopp, O. Vernon, 132 State House, Indianapolis, Ind.
Lott, Earl, Moorestown, N. J.
Lyon, S. C., Box 491, Davidson, N. Carolina.

Mabee, W. B., Box 397, Glasgow, Mont.
MacAndrews, A. H., Coll. of Forestry, Syracuse, N. Y.
Madden, Archie H., Box 592, Charlottesville, Va.
Maloney, G. A., Box 264, Tallulah, La.
Manson, Geo. F., Entomological Lab., Lethbridge, Alberta, Canada.
Marsh, H. L., Box 218, Whittier, Calif.

†Members who attended 1931 meeting.

Marshall, G. E., 630 R. St., Bedford, Ind.
Marshall, James, Annapolis Royal, Nova Scotia, Canada.
Marston, L. Chester, Jr., Univ. of Toronto, Toronto, Canada.
Martin, C. H., 634 S. Washington St., Whittier, Calif.
Martin, J. F., Bureau Plant Industry, Washington, D. C.
Mason, H. C., 151 W. 11th Ave., Columbus, Ohio.
Mayer, C. C. B., O. S. U., Columbus, Ohio.
Mayer, Lionel A., 508 Seaboard Natl. Bldg., Norfolk, Va.
McAlister, L. C., Jr., Cherryfield, Me.
McCampbell, S. C., Zool. Bldg., C. A. C., Fort Collins, Colo.
McCreary, Donald, Dept. Entomology, Newark, Delaware.
McDonald, R. E., 521 Ave. A., San Antonio, Texas.
McEvilly, J. E., Chamber of Commerce, McComb, Miss.
McEvoy, J. A., 136 Church St., Putnam, Conn.
McGarr, R. L., Box 374, Tallulah, La.
McGough, James M., Exp. Station, Santiago de las Vegas, Cuba.
†McGovran, Edward R., State Ent. Bldg., Urbana, Ill.
McKay, R. S., Owensville, Ohio.
McNally, A. Gordon, 390 Colborne St., London, Ontario, Canada.
McNeel, T. E., Zellwood, Fla.
Meachem, F. B., State College, Raleigh, N. C.
Mechling, E. A., Line Street and Coopers Creek, Camden, N. J.
Menagh, C. S., U. S. Bureau of Entomology, Washington, D. C.
Mendenhall, E. W., 97 Brighton Rd., Columbus, Ohio.
Merino, Gonzalo, Dept. Ent., O. S. U., Columbus, Ohio.
Merrill, D. E., 501 W. Sycamore St., Rogers, Ark.
Merritt, James M., Haslett, Mich.
Meymarian, A. T., 8/1/40 New Street, Bagdad, Iraq.
Michelbacher, A. E., 814 Miramar Ave., Berkeley, Calif.
Millar, J. A., 36 Charles St., Wakefield, Mass.
Millar, P. H., State Plant Board, Little Rock, Ark.
Miller, Albert C., 381 W. 9th Ave., Columbus, Ohio.
Mills, Alfred S., Box 223, San Juan, P. R.
†Mills, Harlow, Dept. Ent., Ames, Iowa.
Mills, James, Jr., Hamilton, Glen Co., Calif.
†Milton, Jack, Box 148, Corinth, Miss.
Mohr, Carl, Univ. of Ill., Urbana, Ill.
Monk, J. W., Donna, Texas.
Montgomery, B. Elwood, Purdue Univ., Lafayette, Ind.
†Moody, D. C., Cornelia, Ga.
Moody, D. L., Box 133, Presidio, Texas.
Moore, Warren, Agr. Experiment Station, New Brunswick, N. J.
Moreland, R. W., Bryan, Texas.
Morofsky, Walter F., Dept. Ent., E. Lansing, Mich.
†Morrill, Austin W., Jr., 200 Bland St., Richmond, Va.
Morris, E. L., 812 E. First St., Santa Ana, Calif.
Mortenson, E., Pearsall, Texas.

†Members who attended 1931 meeting.

Murillo, Luis M., Dept. Agr., Bogota, Colombia, S. A.
Murray, Chas. W., Box 1285, Wenatchee, Wash.
Myers, John H., Moweaqua, Ill.
Myers, L. E., Dept. Agr., 308 Wholesale Term. Bldg., Los Angeles, Calif.

Neil, F. A., Room 50, 12 So. Market St., Boston, Mass.
Nel, R. I., Naga Hoeta Estate, Sumatra E. C., Permatang, Siantar.
Nelson, F. C., 118 Chandler Ave., Roselle, N. J.
Nelson, R. H., U. S. D. A. Ent. Lab., Sumner, Wash.
†Nettles, Wm. C., Clemson College, S. C.
Newbegin, I. B., Wakefield, Mass.
Newton, J. H., Paonia, Colo.
†Noble, L. W., Tallulah, La.
Norris, R. K., Pinnacle Packing Co., Medford, Oregon.

O'Dell, J. H., Box 1857, Phoenix, Ariz.
Ohlendorf, Walter, Tlahualilo, Durango, Mexico.
Oertel, E., Bee Culture Field Sta., Baton Rouge, La.
†Osterberger, B. A., La. Exp. Sta., Baton Rouge, La.

Padget, L. J., Box 585, Indio, Calif.
†Parish, H. E., Box 487, Menard, Texas.
Parker, Lawrence B., U. S. Ent. Lab., Moorestown, N. J.
Parr, Thad J., Yale Forest School, New Haven, Conn.
Pearson, Allen M., State College, Ames, Iowa.
Peet, Chas. H., c/o Rohm & Haas Co., Bristol, Penn.
†Peets, Norman D., Box 144, Brookhaven, Miss.
Pegler, Harold C., Box 2833, Los Angeles, Calif.
Pepper, Bailey B., Dept. Ent., Agr. Exp. Sta., New Brunswick, N. J.
Pepper, James H., Dept. Ent., State College, Bozeman, Mont.
Perry, Robert A., 3720 W. 59th Place, Los Angeles, Calif.
Phillips, Arthur M., Baldwyn, Miss.
Phillips, G. L., Baldwyn, Miss.
Phillips, Saul, Conservation Commission, Albany, N. Y.
Pierce, Wm. C., Box 563, Brownwood, Texas.
Piller, A. L., State Capitol Annex, Madison, Wisc.
Plass, Norman H., Vincennes, Ind.
Plumb, Geo. Henry, 17 Compton St., New Haven, Conn.
Plummer, Chas. C., Rancho Amanalco, Cuernavaca, Morelos, Mexico
Pope, J. B., Piura, Peru, S. A.
Powers, E. B., 133 E. Hillvail St., Knoxville, Tenn.
Preston, Roger Lee, 1217-5th Ave., Grinnell, Iowa.
Prevost, E. S., Clemson College, S. C.
Price, L. L., Baton Rouge, La.
Primm, James K., 992 Kingsley Ave., Pomona, Cal.
Proper, Argyle B., Bu. Ent., Melrose Hlds., Mass.

†Members who attended 1931 meeting.

Rainwater, Clyde F., Delta Lab., Tallulah, La.
Rasek, Jaroslav M., Res. Inst. Agr., 201 Ceina Pole, Brno, Czechoslavkia.
Reed, L. B., Box 146, Chadbourne, N. C.
Reed, Thomas Walter, Agr. Exp. Sta., Geneva, N. Y.
Remy, T. P., 2314 Chrysler Bldg., N. Y. City.
Reynolds, Geo. D., Route 1, Silver Spring, Md.
Rice, Paul L., Moscow, Idaho.
Richardson, Henry H., Bur. Ent., Washington, D. C.
Richmond, Roy G., Agl. College, Ft. Collins, Colo.
Riddle, Hazel W., N. D. A. C., Dept. Ent., Fargo, N. D.
Ries, Donald T., Bloomfield Hills, Mich.
Rippey, H. K., 5143 E. Washington St., Indianapolis, Ind.
Roark, C. B., Estacion Expt., Canete, Peru.
Roberts, J. Harvey, Box 376, Univ. Sta., Baton Rouge, La.
Roberts, Raymond, 1329 N. 41st St., Lincoln, Nebr.
Roberts, R. A., Box 509, Uvalde, Texas.
Rolfs, Archie R., Box 243, Yakima, Wash.
Rolfs, P. H., Viscosa E. F., Leopoldina, Minas Geraes, Brazil.
Romney, V. E., Grand Junction, Colo.
†Roney, J. N., Dickinson, Texas.
Root, E. C., Medina, Ohio.
Roseling, R. F., Weslaco, Texas.
Rothe, C. H., Box 1117, Phoenix, Ariz.
Roullard, Fred P., 220 Holland Bldg., Fresno, Calif.
Russell, E. E., Ent. Lab., Tempe, Ariz.
Ryberg, Milton, E., c/o Boyce Thompson Inst. Plant Res., Yonkers, N. Y.

Sakimura, Kay, Univ. of Hawaii, Honolulu, Hawaii.
Salman, Kenneth A., 341 Giannini Hall, Univ. Cal., Berkeley, Calif.
Salt, R. W., Entomological Lab., Lethbridge, Alberta, Canada.
Sanchez, Ernesto e Estrada. Calle 20, No. 21, Entre 15, Vedado, Habana, Cuba.
Sankowsky, N. A., Box 243, Elizabeth, N. J.
Savage, J. R., Agr. Exp. Sta., Wooster, Ohio.
Schaeffer, Melle C., Inst. de Researches d'Insecticides, 23 rue du Laos, Paris, France.
Schenk, Gilbert, 700 W. 74th St., Kansas City, Mo.
Schlupp, Wm. F., Newcomerstown, Ohio.
Schopp, Ralph, U. S. Ent. Lab., Sumners, Wash.
Schread, John C., 247 Vine St., Bridgeport, Conn.
Schwardt, H. H., Univ. Ark., Div. Ent., Fayetteville, Ark.
Shands, W. A., 1630 N. 7th St., Grand Junction, Colo.
†Sheaffer, Frank E., 626 W. 38th St., Indianapolis, Ind.
Shaw, J. Gilbert, 808 Alabama St., Lawrence, Kans.
Sheldon, Howard B., Santa Paula, Calif.
Shepard, Harold H., Univ. Minn., St. Paul, Minn.
†Shropshire, L. H., Box 352, Arlington Heights, Ill.
Shull, W. E., 812 Carroll Ave., Ames, Iowa.

†Members who attended 1931 meeting.

Simmons, Samuel W., Bu. Ent., Washington, D. C.
Simonton, W. A., State College, Ames, Iowa.
Singleton, J. M., Hidalgo, Texas.
Slack, Torbert, Box 773, Lake Charles, La.
Sleesman, G. B., Box 23, North Glenside, Pa.
Slocum, Burl A., Cornell Univ., Ithaca, N. Y.
Smith, Charles M., 424 Allison St., N. W., Washington, D. C.
Smith, Geo. A., Dept. Conservation, Boston, Mass.
Smith, Geo. E., Albion, N. Y.
Smith, Leslie, M., U. C. Deciduous Fruit Sta., San Jose, Calif.
Smith, R. G., 55 Payson Ave., New York, N. Y.
Smith, Sydney D., Box 798, San Antonio, Texas.
Smith, W. F., 152 S. Lake Ave., Pasadena, Cal.
Soliman, Labib B., Cotton Res. Board, Giza, Egypt.
Spangenberg, Herbert, 137 N. San Joaquin St., Stockton, Cal.
Stabe, Henry A., Lansing, Iowa.
Stanley, W. W., Tenn. Agr. Exp. Sta., Knoxville, Tenn.
Steenburg, W. E., 228 Dundee St., E., Belleville, Ontario, Canada.
Steinweden, J. B., 149 Calif. St., San Francisco, Calif.
Stevenson, W. A., Box 1910, Tucson, Ariz.
†Stewart, M. A., Rice Inst., Houston, Texas.
Stickney, F. S., 724 Earlham Drive, Whittier, Calif.
Stiles, C. F., Box 37, Stillwater, Okla.
Stirland, La Grande, Providence, Utah.
Stitt, Lloyd L., U. S. Ent. Lab., Tempe, Ariz.
Stone, M. W., Box 297, Alhambra, Calif.
Stracener, C. L., La. Exp. Sta., Baton Rouge, La.
Sullivan, Wm. N., 7710 Blair Rd., Takoma Park, Md.
Strand, Thomas P., c/o Cal. Spray Chem. Co., Wenatchee, Wash.
Struble, G. R., 341 Giannini Hall, Univ. of Calif., Berkeley, Calif.
†Summerland, S. A., Bentonville, Ark.
Swingle, Millard C., 7710 Blair Rd., Takoma Park, Md.
Symonds, C. M., Bureau of Entomology, Melrose Hlds., Mass.

Talbert, T. J., Whitten Hall, Columbia, Mo.
Tate, H. D., State College, Ames, Iowa.
Thompson, Friar M., Jr., Rutgers College, New Brunswick, N. J.
Thompson, Robert W., Dept. Entomology, Guelph, Canada.
†Thompson, W. L., Lake Alfred, Fla.
Thomson, J. R., Box 445, Ft. Valley, Ga.
Thurber, George A., State College, Ames, Iowa.
Tischler, Nathaniel, 215 Chamberlain Place, Ames, Iowa.
Tolles, G. S., R. R. 5, South Haven, Mich.
Townsend, James F., 278 Canner St., New Haven, Conn.
Townsend, L. H., Univ. of Ill., Urbana, Ill.
Toyne, Arthur, 404 Cypress Ave., Pasadena, Calif.
Travis, Bernard, State College, Ames, Iowa.

†Members who attended 1931 meeting.

Tubbs, D. W., Tustin, Calif.
Tuckett, J. E., Indio, Calif.

Ulman, P. T., European Corn Borer Control, Auburn, Ind.

Van Aller, T. S., 902 Charleston St., Mobile, Ala.
Vanderford, H. T., Maben, Miss.
Van der Meulen, P. A., Rutgers Univ., New Brunswick, N. J.
Van Horn, Clair, Room 1, Masonic Bldg., Meadville, Pa.
Vickery, R. K., 1118 Oxford St., Berkeley, Calif.
Vinzant, M. G., 1401 Buena Vista Ave., Laredo, Texas.
Vogel, M. A., Experiment Station, Wooster, Ohio.

Wagner, G. B., Dept. Ent., K. S. A. C., Manhattan, Kans.
†Wall, R. E., Experiment Station, Bozeman, Mont.
Wallis, R. L., Bureau of Entomology, Melrose Hlds., Mass.
Warren, Allen J., 59 Lincoln St., New Haven, Conn.
Waters, Harold A., B. & Z. Bldg., O. S. U., Columbus, Ohio.
Watson, J. R., Agr. Exp. Sta., Gainesville, Fla.
Watson, Lloyd R., Alfred, N. Y.
Watson, S. A., 321 S. Washington Ave., Whittier, Calif.
Watts, H. R., Box 1022, Louisville, Ky.
Watts, J. G., Clemson College, S. C.
Webb, R. J., Drawer 359, Monroe, Mich.
Weed, C. M., State Normal School, Lowell, Mass.
Wells, A. B., Bryn Athyn, Pa.
West, L. S., Battle Creek College, Battle Creek, Mich.
Wheeler, A. J., Madison, Tenn.
Whitten, Russell R., 104 Ashland St., Melrose Hlds., Mass.
Wilbur, D. A., K. S. A. C., Manhattan, Kansas.
Willey, C. R., Room 1112, State Office Bldg., Richmond, Va.
†Williams, L. L., Box 374, Dover, Del.
Williams, Orville L., Bayard, Iowa.
Williams, V. E., 1324 Elm Ave., San Gabriel, Cal.
Williamson, Amis L., International Bridge, Hidalgo, Texas.
Williamson, Warren, R. D. 5, Galesburg, Ill.
Wilson, G. R., 1620 Santa Clara Ave., Alameda, Calif.
Winchester, H. I., R. D. 1, Wakefield, Mass.
Wisecup, C. B., Sanford, Fla.
Woke, Paul A., Bu. Ent., Tallulah, La.
Wolfenbarger, D. O., Dept. Ent., Cornell Univ., Ithaca, N. Y.
Woodrow, A. W., Dairy Bldg., Cornell Univ., Ithaca, N. Y.
Woodruff, Lawrence C., 1212 Louisiana St., Lawrence, Kans.
Woodside, A. M., Blacksburg, Va.
Woodworth, Charles E., 516 Union Ave., Walla Walla, Wash.
Wray, David L., Jr., Dept. Agr., Raleigh, N. C.
Wright, Percy F., 513 S. School St., Lodi, Calif.

†Members who attended 1931 meeting.

Yeates, James M., Box 374, Tallulah, La.
York, Converse H., 600 Wing St., Glendale, Calif.
York, Geo. T., Box 703, Riverside, Calif.
Young, H. C., Box 1910, Tucson, Ariz.
Young, H. D., Bur. Chem. & Soils, Washington, D. C.

Zeimet, Carlo, Bur. Ent., Washington, D. C.
Zeisert, C. C., R. R. 6, Brookville, Ohio.
Ziegler, L. W., 1251 W. Masonic St., Apt. No. 1, Gainesville, Fla.
Zimmerman, H. K. (Mrs.), 317 Kensington Ave., Astoria, Oregon.
Total number of Associate Members, 565.

FOREIGN MEMBERS

Anderson, T. G., Nairobi, British East Africa.
Aulló, Costilla, Dr. Manuel, Laboratorio de la Fauna Forestal Espanola, Ferraz, 40 Madrid, Spain.

Ballou, H. A., West Indian Agricultural College, St. Augustine, Trinidad, West Indies.
Bordage, Edmond, Directeur de Musee, St. Denis, Reunion.
Brain, Charles K., University of Stellenbosch, Stellenbosch, C. P. South Africa.

Carpenter, Dr. George H., University of Manchester, Manchester, England.
Collinge, W. E., 55 Newhall St., Birmingham, England.

Danysz, J., Laboratorie de Parasitologie, Bourse de Commerce, Paris, France.
DeBussy, L. P., Kolonial Instit., Mauritskade 65–66, Amsterdam, Holland.

Escherich, K., Forstliche Versuchsaustalt, Universitat, Munich, Germany.

Filipjev, T. N., Gertzena 44, Leningrade, Russia.
French, Charles, Department of Agriculture, Melbourne, Australia.
Froggatt, W. W., 12 Young St., Croyden, Sydney, New South Wales.

Goding, F. W., Box 448, Livermore Falls, Maine, U. S. A.
Grasby, W. C., 6 West Australian Chambers, Perth, West Australia.
Green, E. E., Way's End, Beach Ave., Camberley, Surry, England.

Harukawa, Chukichi, Kurashiki, Okayama-Ken., Japan.
Herrera, A. L., Care Secretaria de Agricultura y Fomento, Mexico, D. F. Mexico.
Hill, Gerald F., 5 Clifton Rd., Hawthorn, Melbourne, Australia.
Horvath, Dr. G., Museum Nationale Hungaricum, Budapest, Hungary.

Jablonowski, Josef, Entomological Station, Budapest, Hungary.
Jack, Rupert W., Salisbury, Rodesia, South Africa.
Johnson, Thomas H., University of Brisbane, Queensland, Australia.

Kulagin, Nikolai M., Petrovsky-Rasumovsky Academy, Petrovsko-Rasumovskoie, Moscow, Russia.
Kuwana, S. I., Imperial Agricultural Experiment Station, Yokohama, Japan.

Lea, A. M., National Museum, Adelaide, South Australia.
Lounsbury, Charles P., 795 Church St., East, Pretoria, South Africa.

Mally, C. W., University of Stellenbosch, Stellenbosch, C. P., South Africa.
Marchal, Dr. Paul, 16 Rue Claude-Bernard, Paris, France.
Mokrzecki, Dr. Sigismond, Director, Instit. of Forest Protection and Entomology, Skierniewice, Poland.
Mussem, Charles T., Hawkesbury Agricultural College, Richmond, New South Wales.

Nawa, Yashushi, Entomological Laboratory, Kyomachi, Gifu, Japan.
Newstead, Robert, University School of Tropical Medicine, Liverpool, England.

Parker, Theodore, Leeds University, Leeds, England.
Porter, Carlos E., Casilla 2352, Santiago, Chili.
Pospielow, Dr. Waldemar, Bureau of Entomology, Morskaya 44, Petrograd, Russia.

Read, Charles S., Mendoza, Argentine Republic, South America.
Rosenfeld, A. H., Am. Sugar Cane League, 1005 New Orleans Bank Bldg., New Orleans, La.
Ruzkowski, J. W., Solacka, Poznan, Poland.

Sajo, Prof. Karl, Godollo-Veresegyhaz, Hungary.
Scaramuzza, L. C., Camaguey, Cuba.
Schoyen, Prof. W. M., Zoological Museum, Oslo, Norway.
Severin, Prof. G., Curator Natural History Museum, Brussels, Belgium.
Silvestri, Dr. F., R. Scuola Superiore di Agricoltura, Portici, Italy.
Stellwaag, Dr. Frederich, Neustadt, a. d. Haardt, Germany.

Theobald, Frederick V., Wye Court, Wye, Kent, England.
Thompson, Rev. Edward H., Franklin, Tasmania.
Tillyard, R. J., Cawthron Institute of Scientific Research, Nelson, New Zealand.
Tragardh, Ivor, Experimental Faltat, Stockholm, Sweden.
Trouvelot, Bernard, Inst. Agr. Research, Paris, France.
Tryon, H., Queensland Museum, Brisbane, Queensland, Australia.

Urich, F. W., Department of Agriculture, Port of Spain, Trinidad, West Indies.

Total Number of Foreign Members, 52
Life Members, 6
Grand Total of Members, 1238

JOURNAL
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OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS
VOL. 25 FEBRUARY, 1932 No. 1

The Proceedings of the 44th Annual Meeting of the American Association of Economic Entomologists

The 44th annual meeting of the American Association of Economic Entomologists was held in the Municipal Auditorium, New Orleans, Louisiana, December 29–31, 1931.

The opening session was held at 10 a. m. December 29, and sessions having a program of special papers were held in the afternoon and on the following day.

On Thursday morning December 31, a joint meeting was held with the Cotton States Branch and two special papers were delivered, one by W. B. Herms and the other by W. C. O'Kane. At the close of this session the final business meeting was held and the meeting adjourned at 12:20 p. m.

The Section of Apiculture and the Section of Plant Quarantine and Inspection held meetings in the afternoon of December 29. On the morning of December 30, the Section of Plant Quarantine and Inspection held its second session and at the same time a session was held by the Section of Extension.

In the afternoon of December 30, papers on Insect Toxicology and Insect Physiology were presented at a special session.

Sectional Officers were elected as follows:

Section of Apiculture

E. F. Phillips Ithaca, N. Y., Chairman
E. J. Anderson, State College, Pa., Secretary

Section of Plant Quarantine and Inspection.

W. A. Price, Lexington, Ky., Chairman
S. B. Fracker, Washington, D. C., Secretary

Section of Extension

L. A. Stearns, Newark, Del., Chairman
M. P. Jones, Washington, D. C., Secretary

The Entomologists Dinner was held at La Louisiane Restaurant on Wednesday evening, December 30. There was a large and enthusiastic attendance. The President introduced Doctor Wilmon Newell as Toastmaster who, in turn, presented Professor Herbert Osborn as the honored guest of the evening. Music was furnished by a quartet from Southern College and the selections rendered were greatly enjoyed by all present. The occasion was a most pleasant one and will be remembered with much pleasure by all those who were able to be present.

The address of the President of the Association was delivered Wednesday morning on "Some Problems in Economic Entomology," and is presented in full in this report.

The membership of the Association was increased by 89 members, 85 by election and 4 by reinstatement.

W. P. Flint, Urbana, Illinois, was elected President for the ensuing year.

PART I. BUSINESS PROCEEDINGS

The meeting was called to order at 10:20 a. m. December 29, by President J. S. Houser; 200 members and visitors were in attendance at this session and the names of the members who signed the register are indicated by a dagger in the printed membership list.

PRESIDENT J. S. HOUSER: It is my great honor to call to order the 44th annual meeting of the American Association of Economic Entomologists.

The first order on the program is the report of the Secretary.

REPORT OF THE SECRETARY

The membership at the time of the Cleveland Meeting totaled 1144 and included 5 life members. The membership was increased by election, transfers and reinstatements and reduced by members dropped for the nonpayment of dues and several deaths. The present membership is 1201, listed as follows: Active 600; Associate 549; Foreign 52; Life members 6, making a net gain of 57. There are at present 8 active and 34 associate members who will be dropped January 1st unless their dues are paid.

The conditions prevailing throughout the United States and other sections of the world have been reflected to some extent in our organization. There is a tendency for members to drop from the rolls, reducing the support of the JOURNAL. The condition has not been serious the past year but probably will be more noticeable during the next 12 months.

The records that are available indicate that 3 active members have died during the year.

Professor J. H. Comstock, Professor of Entomology at Cornell University died March 20, 1931. He was one of our oldest and most respected members. His work in Entomology is a fitting monument to his memory.

Professor R. Lowry died at Durham, N. H. For a number of years he had been

Associate Professor of Entomology at the University of New Hampshire and his sudden death was a great shock to his many friends.

Professor George H. Lamson, Jr., died in New York City on December 3, 1931. He was the head of the Department of Entomology and Zoology at the Connecticut State College and had served that institution for many years.

Mr. A. C. Morgan, who had for many years been employed by the Bureau of Entomology on Tobacco Insect Investigation in the South and had for a long period of years made his headquarters at Nashville, Tenn., died at his home in that city. He was until recently an active member of the Association and had carried on very creditable work in his special field.

Mr. A. H. Kirkland, a past president of this Association, died at his home at Concord Depot, Va., August 29, 1931. He was a native of Massachusetts, having graduated from the State College in 1894. For a number of years he had charge of the Gipsy Moth work in that State and was highly esteemed by a wide circle of friends.

The Sixth Annual Meeting of the Cotton States Branch was held on February 5 and 6, 1931. The attendance was 65 members. The following officers were elected: Chairman, R. W. Harned, A. & M. College, Miss., Vice-Chairman, Herbert Spencer, Baton Rouge, La., Secretary, O. I. Snapp, Fort Valley, Ga.

The Sixteenth Annual Meeting of the Pacific Slope Branch was held June 17 and 19, 1931 at Pasadena, California. The attendance averaged 179. President J. S. Houser attended this meeting and addressed the branch on matters connected with the General Association. The following officers were elected: Chairman, G. M. List, Fort Collins, Colorado; Vice-Chairman, A. M. Boyce, Riverside, California; Secretary, H. A. Scullen, Corvallis, Oregon.

The Third Annual Meeting of the Eastern Branch was held in the American Museum of Natural History in New York City on November 19 and 20, 1931. The attendance was the largest that this branch has had, averaging 140. The following officers were elected: Chairman, L. M. Peairs, Morgantown, W. Va.; Vice-Chairman, Hugh Glasgow, Geneva, N. Y.; Secretary-Treasurer, H. B. Weiss, New Brunswick, N. J.

Indices to the Literature of American Entomology

Indices I and II:

The sales of these indices during the current year have amounted to $129.15. There is still an ample supply of these books available.

Index III:

The sales of this index dropped slightly during the year amounting to $106.45. There is an ample supply of this volume on hand.

Index IV:

This volume had been printed and was ready for distribution at the time of the Annual Meeting last year. The gross sales to date have amounted to $1153.66. The cost of the publication, including the editing, printing, and mailing, together with the small amount of advertising matter sent out amounted to $2553.17. In order to finance the publication it was necessary to transfer $1820 from Indices I and II account. During the year $420 of this amount has been repaid so that Index IV now has a deficit of $1400. The price of this volume has been held at $5.00 a copy. It is hoped that more members and institutions will add this volume to their libraries during the coming year.

JOURNAL OF ECONOMIC ENTOMOLOGY

Volume 24 of the Journal of Economic Entomology has just been completed and contains 1331 printed pages, being the largest volume that has ever been published and exceeding the volume of the previous year by nearly 300 pages. The subscription list has increased somewhat during the year and the balance carried over is somewhat less than during the previous year. It has been possible to print this large number of pages as a result of the small increase in the subscription list, some additional funds that have been received from advertising and the payment by the authors for printing which over run the 6 page limit.

Complete sets of the JOURNAL are available with the exception of a few Volumes, some numbers of which are out of print.

The geographical distribution of the subscribers is indicated by the following table compiled for the years 1913, 1923, 1930 and 1931.

The following table shows the total domestic and foreign subscribers in 1913, 1923, 1930 and 1931:

	1913	*1923*	*1930*	*1931*
Alabama	3	9	10	10
Arizona	7	8	21	22
Arkansas	2	4	8	7
California	34	67	144	154
Colorado	7	12	15	16
Connecticut	10	15	28	28
Delaware	3	3	8	8
District of Columbia	50	55	61	70
Florida	7	15	33	27
Georgia	6	10	17	22
Idaho	2	6	11	16
Illinois	30	31	38	40
Indiana	16	15	25	30
Iowa	5	12	20	20
Kansas	16	16	25	21
Kentucky	4	5	8	8
Louisiana	12	17	33	31
Maine	5	7	9	9
Maryland	11	14	24	29
Massachusetts	48	76	75	65
Michigan	15	10	26	27
Minnesota	10	14	16	21
Mississippi	4	22	36	36
Missouri	8	12	19	20
Montana	5	7	8	8
Nebraska	3	3	9	9
Nevada	1	2	3	3
New Hampshire	4	9	7	7
New Jersey	14	22	45	45
New Mexico	3	3	3	4
New York	52	69	93	93
North Carolina	6	8	19	21
North Dakota	0	1	3	2
Ohio	22	34	69	80
Oklahoma	2	5	8	8
Oregon	10	12	26	25
Pennsylvania	18	38	42	47
Rhode Island	3	7	4	4
South Carolina	4	2	12	10
South Dakota	1	2	4	3

	1913	1923	1930	1931
Tennessee	6	11	18	21
Texas	16	21	61	58
Utah	8	9	21	19
Vermont	1	1	2	2
Virginia	7	16	23	23
Washington	8	8	21	26
West Virginia	5	5	5	7
Wisconsin	6	13	20	19
Wyoming	0	2	3	3
Total for U. S.	520	765	1234	1294
U. S. Insular Possessions and Cuba	26	—	—	—
Hawaii	—	11	17	20
Alaska and Panama	—	2	1	2
Philippines	—	5	6	5
Porto Rico and Cuba	—	7	16	17
Canada	27	47	55	59
Foreign	132	183	347	362
GRAND TOTAL	705	1020	1681	1759

There is attached hereto a statement of the cash received and disbursements made by the Association, the Journal and Index Accounts, and also of the Permanent Fund, which has been audited by White, Hickox and Company, Certified Public Accountants, Boston, Mass.

Respectfully submitted,
A. F. BURGESS,
Secretary

AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

November 17, 1931

CERTIFICATE

We have examined the records, books and accounts of the Secretary of the American Association of Economic Entomologists for the period from November 15, 1930 to November 17, 1931, inclusive.

All recorded income was traced into the Association's bank accounts, all disbursements were found to be supported by proper vouchers. The cash balances at November 17, 1931 were confirmed directly to us by the depositories.

The Permanent Fund securities were counted by us and the deposits in the bank were verified. We satisfied ourselves that all income earned by this Fund was properly accounted for, and all transfers from other sources were authorized.

Boston, Mass.,
November 24, 1931

WHITE, HICKOX & COMPANY,
Certified Public Accountants

STATEMENT OF CASH RECEIPTS AND DISBURSEMENTS AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

For the period from November 15, 1930 to November 17, 1931

	Total	Journal	Association	Index IV	Index III	Index I and II
Balance, November 15, 1930	$8,227.96	$4,575.72	$1,527.53	$ 329.00	$ .25	$1,795.46
Income						
Sales	1,060.26			824.66	106.45	129.15
Transfer from Index I and II	1,820.00			1,820.00		
Transfer from Index III	100.00					100.00
Transfer from Index IV	420.00					420.00
Subscriptions, advertising and miscellaneous	6,805.62	6,805.62				
Dues and separates	1,486.95		1,486.95			
	19,920.79	11,381.34	3,014.48	2,973.66	106.70	2,444.61
Expenses						
Printing	7,429.38	5,283.50		2,145.88		
Halftones and engravings	593.86	593.86				
Postage	563.96	419.71	103.58	35.97	1.99	2.71
Supplies and Stationary	133.31	58.48	74.83			
Telegraph, Freight and Express	21.80	9.48		12.32		
Editor	450.00	100.00		350.00		
Secretary	200.00	100.00	100.00			
Clerical Work	613.60	490.00	123.60			
Transfer to Permanent Fund	1,500.00	600.00	900.00			
Stenographic report	87.36		87.36			
Typewriter	60.00		60.00			
Auditing	50.00		50.00			
Bond for Secretary	12.50		12.50			
Checks returned	113.80	95.30	9.50	9.00		
Transferred to Index IV	1,820.00					1,820.00
Transferred to Index I and II	520.00			420.00	100.00	
Total Expenses	14,169.57	7,750.33	1,521.37	2,973.17	101.99	1,822.71
Balance, November 17, 1931	$5,751.22	$3,631.01	$1,493.11	$ .49	$ 4.71	$ 621.90

The balance is on deposit at the:

Franklin County Trust Co., Greenfield, Mass.—Commercial Department	$2,751.22
First National Bank, Malden, Mass.—Certificates of Deposit	3,000.00
	$5,751.22

PERMANENT FUND AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS
For the period from November 15, 1930 to November 17, 1931

Balance, November 15, 1930 per previous report		$10,648.92
Additions		
Interest from securities	$ 173.67	
Interest from Savings Bank Deposits	305.84	
Interest from Index, Journal and Association accounts	229.42	
Transfer from Journal account	600.00	
Transfer from Association account	900.00	2,208.93
Balance, November 17, 1931		$12,857.85

Invested as follows:

Par Value	*Bonds*		
1500	United States Liberty 4¼%	$1,500.00	
2000	Province of Ontario 5%	2,000.00	
4000	Federal Land Bank 4¼%	3,550.00	$7,050.00
	Bank Deposits		
	Savings Banks		
	Melrose Savings Bank, Melrose, Mass	$1,580.93	
	Malden Savings Bank, Malden, Mass	1,679.70	
	Savings Department, Trust Companies		
	Melrose Trust Co., Melrose, Mass	817.80	
	Franklin County Trust Co., Greenfield, Mass	1,698.24	
	Commercial Department, Trust Company		
	Franklin County Trust Co., Greenfield, Mass	31.18	5,807.85
			$12,857.85

Voted that the report be accepted.

PRESIDENT J. S. HOUSER: The next order of business is the report of the Executive Committee.

REPORT OF THE EXECUTIVE COMMITTEE

One of the first official acts of your President was the appointment of a committee on general arrangements for the next meeting. Dr. W. E. Hinds was appointed chairman with instructions to associate with him any others whom he wished to choose. Dr. E. R. Barber and Mr. T. E. Holloway were selected. Later, Dr. R. W. Harned, President of the Cotton States Branch was asked to appoint a committee from that Branch of the Association to assist the general committee. Dr. J. M. Robinson, O. I. Snapp and Dr. R. W. Leiby were chosen.

In compliance with an action taken at the final business session of the forty-third meeting, a special committee on program arrangement for the present meeting was appointed. This committee consisted of Mr. A. F. Burgess, Dr. T. J. Headlee, and Prof. W. C. O'Kane.

The last report of the Executive Committee suggested that the President for 1931 consider arrangements for a feature address of special interest to our members. Following the work of the special committee on program, this seemed inadvisable and the invitation section of our program represented by papers 101, 102, 103, and 104 is offered as a substitute.

It was also provided last year that a special committee of two be appointed to investigate transportation facilities and other details connected with the Fifth Inter-

national Congress of Entomology to be held in Paris in 1932. Prof. O. A. Johannsen and Dr. Albert Hartzell constitute this committee.

Certain changes in the Constitution and By-Laws were suggested in the last report of the Executive Committee. A committee consisting of Prof. W. A. Price, Mr. A. F. Satterthwait and Dr. C. R. Cutright was appointed to consider the changes and report at the present meeting.

In response to an invitation extended by Prof. W. C. Curtis, President of the Union of Biological Societies, your President attended a conference at Washington, D. C., March 7, 1931. This conference was participated in by the Executive Committee of the Union and a representative from the majority of the twenty-nine member societies or sections thereof. It was called largely for the purpose of considering ways and means for continuing the publication of Biological Abstracts. A full report of this conference was published in the May 15, 1931 issue of Science. The Rockefeller Foundation, which to date has in large measure supported Biological Abstracts, has suggested that financial support should be received from the societies composing the membership of the Union and that the individual biologists should in larger numbers subscribe for the Abstracts. The Foundation has intimated that in the absence of such response, it might be disposed to withdraw its aid.

Your Executive Committee realizes the present and potential future value of Biological Abstracts, and since some of the other societies have contributed to the support of this enterprise, it recommends that $100.00 be subscribed from the general fund of this Association, payment thereof being made when the Executive Committee of this Association is satisfied that the publication of Biological Abstracts is to be continued. The committee further recommends that as many as possible of the members subscribe individually, and that their respective institutions, if not already subscribing, be urged to do so.

Inasmuch as neither of our duly elected councilors to the Union could attend the New Orleans meeting of the Council, Dec. 28, Dr. E. D. Ball and Dr. S. W. Bilsing were asked to serve in this capacity.

Prof. P. J. Parrott was asked to serve as the official representative of the Association at the funeral of the late Prof. J. H. Comstock.

Your President is pleased to report that he was able to attend the meeting of the Pacific Slope Branch, June 17–19, 1931 at Pasadena, California, where an attendance of 179 was recorded. He can add whole heartedly one more superlative to the many of which California is justly proud—that as a host to wandering entomologists, she is top-notch.

A communication has been received from the Pacific Slope Branch regarding the publication of papers in the Journal. The suggestion is made that the incoming President appoint a committee of five to thoroughly consider the entire publication policy of the Journal and report at the next annual meeting. The Executive Committee looks favorably upon this proposal and recommends that such a committee be appointed.

The attention of the Executive Committee has been directed to the desirability of making a careful study of the general activities of the Association and of the need for formulating comprehensive plans for future development. These matters will be considered by the Committee during the coming year and authority is requested by the Committee to enlist the services of members who may give helpful advice in these matters.

Dr. W. H. Larrimer participated in the work of the Membership Committee

throughout the year but was unable to attend this meeting. Mr. J. E. Dudley, Jr., was asked to substitute for him in the final work attending the preparation of the Committee's report.

The Executive Committee recommends that the President for 1932 appoint two delegates and two alternates to represent this Association at the Fifth International Entomological Congress at Paris and that the President himself serve as one of the delegates in the event he attends the meetings of the Congress.

The Executive Committee approved the transfer of $600.00 from the Journal Account and $900.00 from the Association Account to the Permanent Fund of the Association. The financial reports of the Secretary and the Trustees of the Permanent Fund have been audited by a firm of certified public accountants.

The Executive Committee has received the following communication from Secretary Burgess:—"I am writing to present to you my resignation as Secretary of the Association and Business Manager of the Journal, to take effect at the close of the annual meeting at New Orleans.

My term of office does not expire until the annual meeting in 1932, but on account of pressure of other work I think it best to retire at this time."

Your committee has exhausted the possibilities of inducing Mr. Burgess to continue at least to the end of his present term, therefore: In view of the long and efficient service Mr. Burgess has rendered the Association, it is with extreme regret the Executive Committee recommends that his resignation as Secretary and Business Manager of the Journal be and is hereby accepted, but that the date of terminating his service be extended to February 1, 1932 in order that the business accruing from this meeting be satisfactorily completed.

The Executive Committee recommends that if a paper presented at a meeting is withdrawn for publication elsewhere, unless place and time of publication is indicated, all mention of the paper and any discussion pertaining thereto be eliminated from the proceedings of the meeting.

For the Committee,
J. S. HOUSER,
President

Voted that the report be accepted and the recommendations adopted.

PRESIDENT J. S. HOUSER: The next order of business is the report of the Governors of the Crop Protection Institute.

REPORT OF BOARD OF GOVERNORS OF THE CROP PROTECTION INSTITUTE

In the year 1931 the Crop Protection Institute has had active projects on hand, as follows:

Summer oil sprays as adapted especially to conditions in the central states.—Headquarters of this project at Urbana, Ill.

Further studies of pyrethrum culture.—Headquarters in Pennsylvania, with supplementary work in various additional states.

Utilization of flotation sulphur, both alone and in combination with other materials.—Headquarters at Urbana, Ill.

Studies of methods of extraction of pyrethrum and combination of such extracts with various wetting agents.—Headquarters in Massachusetts.

Research in fungicides adapted for use in combination with oil sprays.—Headquarters in New Jersey.

Further studies of cocoanut fatty acids as insecticides.—Headquarters in Maryland.

Further research in control of oriental fruit moth by spraying.—Headquarters in Delaware.

Control of codling moth in Washington by oil sprays.—Headquarters in Pullman, Washington.

Control of the codling moth in California.—Headquarters at Berkeley, Calif.

Survey of the total volume of spray materials used in the United States.—Headquarters in New Hampshire.

Studies of certain groups of synthetic organic compounds as insecticides.—Headquarters in Iowa.

Research in a new type of colloidal sulphur.—Headquarters in Delaware.

Investigation of certain iodine compounds as fungicides.—Headquarters in New Jersey.

Studies of a group of synthetic organic compounds, both as insecticides and as fungicides.—Headquarters in Ohio.

Further work with a special impregnated, adhesive tape for use in nursery grafts.—Headquarters in Wisconsin.

A new research project which is to be started immediately will be concerned with the use of carbon dioxide—solid, liquid, and gaseous—in connection with the application of liquid insecticides and in connection with fumigation.

Publications for 1931 are as follows:

Bulletin No. 31, Monochlornaphthalene as an Insecticide.
Bulletin No. 32, An Insecticidal Method for the Estimation of Kerosene Extracts of Pyrethrum.
Bulletin No. 33, Some Physical Properties of Certain Dormant Oil Emulsion-Sulphur Combinations.
Bulletin No. 34, The Pyrethrin I Content of Pyrethrum Powders as an Index of Insecticidal Power.
Bulletin No. 35, Volck Special Emulsion Number 2 as a Control for External Parasites of Animals.

W. C. O'KANE, *Chairman*,
Durham, New Hampshire

Voted that the report be adopted.

PRESIDENT J. S. HOUSER: The next will be the report of the Scientific Trustee of the Tropical Plant Research Foundation.

REPORT OF THE TROPICAL PLANT RESEARCH FOUNDATION

As many of the members of the Society probably know, the work of the Foundation has been much restricted on account of the business conditions and especially the desperate situation of the sugar cane industry in Cuba where our principal work has been located. At a meeting of the Trustees last April it was decided to curtail activities so as to keep within probable income and it was arranged that Doctor Crocker should serve as acting director and the officers headquarters located temporarily at the Boyce-Thompson Institute, an arrangement which enables the Foundation to maintain its organization, to carry forward minor projects for which it has some funds available, and to be in a position to resume larger operations at any time that

financial conditions may permit. The principal station located at Baraguá, Cuba, is continuing the work on a much restricted program and a recent letter from Professor Van Dine, the local director, may be quoted as summing up the present situation and prospects for the immediate future:

My dear Dr. Osborn:

"Herewith a manuscript on 'A Report on the Corn Aphis, *Aphis maidis* Fitch, in Cuba,' by Loftin and Christenson of this Station. It is proposed to publish this report under the Scientific Contribution series of the Tropical Plant Research Foundation if our funds will allow, providing it has your approval and that of Dr. Crocker at Boyce-Thompson and request that you write to him direct in the matter of its publication. This is the final report on mosaic and the insect which transmits the disease, the project having been discontinued.

"There remains with me at the Station Mr. Priode on pathology, Mr. Christenson on entomology and Mr. Sorensen on varieties, Faris, Loftin, Plank, Jensen and Scaramuzza having closed out their work and left us during the year. The present budget provides for the work to be continued until the end of this fiscal year, June 30th, although some of same will be closed out in the meantime. We are trying to bring together the results of all of our work that has not up to this time been published, so that the work can be terminated with as little loss as possible, and, also, that continuity will be insured if any similar investigations are undertaken in Cuba at some future time."

While it is evident that the operations of the Foundation must be reduced, it is sincerely hoped that conditions may permit renewed activity and the arrangement for other projects which may be of importance in the investigation of biological problems in tropical regions.

Respectfully submitted,
HERBERT OSBORN,
Trustee

Voted that the report be accepted and published.

PRESIDENT J. S. HOUSER: I will now call for a report on the Session of the Union of Biological Societies which was held yesterday.

Mr. Herbert Osborn stated that those attending the meeting were unanimous in supporting the Abstracts as strongly as possible and urged every one to help the project along. I think we should use our best efforts in its support. It is an International rather than a National affair and needs all the support that can be given.

Voted that the report be accepted.

PRESIDENT J. S. HOUSER: We will now hear the report of the Editorial Board on the Index to Economic Entomology.

REPORT OF EDITORIAL BOARD ON INDEX TO AMERICAN ECONOMIC ENTOMOLOGY

Index IV, as recorded in the report of your committee for the preceding year, was completed and distribution commenced the latter part of December. This Index, together with the three preceding, cover the literature of the past 25 years.

There has been no occasion for special activity the past year. The records in regard to sales are given in the report of the Secretary and need not be reported here. The committee recommends, as last year, that the Editorial Board of the Journal be continued in charge of the Index and that it be instructed to report at the proper time upon the possibilities of publishing an Index for the five year period ending December 31, 1934.

Respectfully submitted,
E. P. FELT
D. M. DELONG
A. F. BURGESS
Committee

Voted that the report be accepted and the recommendations adopted.

PRESIDENT J. S. HOUSER: We will now listen to a report of the Committee on Research Work on the Control of the European Corn Borer.

REPORT OF JOINT COMMITTEE ON THE EUROPEAN CORN BORER

APPOINTED BY

AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS,
AMERICAN SOCIETY OF AGRONOMY,
AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS,
AMERICAN FARM ECONOMIC ASSOCIATION,
AND
AMERICAN SOCIETY OF ANIMAL PRODUCTION

1931

The natural spread and increase of the European corn borer, which was retarded by the abnormal season of 1930, was resumed in 1931. The intensity of infestation in 1931 was about two and a half times that of 1930 and more than twice that of 1929. Although the past season cannot be regarded as having been exceptionally favorable for the corn borer, some of the serious infestations recognized as possible in the 1930 report of this committee actually occurred. As a result, there is a much larger number of larvae at present than in the fall of 1930, with a consequently greater danger for 1932. The increase in borer population was particularly heavy (1) in northwestern Ohio, south of the former center of infestation along Lake Erie, and (2) in the important sweet corn area along the southern and eastern shores of Lake Ontario in New York.

The present infested area includes all of the corn-growing areas in Canada, excepting the western provinces; also 220,000 square miles in the United States, including the southern two-thirds of New England, northern part of New Jersey, all of New York, three-fourths of Pennsylvania, the panhandle of West Virginia, practically all of Ohio, the northeastern half of Indiana and nearly all of the agricultural portion of Michigan. In the area east of the Connecticut River in Connecticut, Massachusetts and states north, in that territory in Connecticut west of the river adjacent to Long Island Sound, and in restricted localities in New Jersey, the two-brooded form occurs, while in all other infested sections of the United States and all infested areas in Canada, excepting Nova Scotia and New Brunswick, only the one-brooded form occurs. Small isolated infestations occurred in eastern Wisconsin, northern Kentucky, and extreme southern Indiana.

The increase in spread and infestation in 1931 further demonstrates that seasons of increase and decrease in borer abundance will occur as with other crop pests. Temporary checks to the corn borer in individual seasons, such as that in 1930, must not be interpreted as minimizing the seriousness of the insect as a destructive agency.

The large increase in borer population in 1931 emphasizes that the European corn borer is one of the most potentially destructive crop pests ever introduced into America. This fact calls for the continued cooperation of the farmer, the scientist, the educator, and all State and Federal administrative officials.

The joint committee of entomologists, agronomists, agricultural engineers, agricultural economists, and animal husbandmen, commends the efforts of all farmers practicing recommended control measures and of those engaged in the research, regulatory, and educational activities.

The committee recognizes the necessity for the continuation of the research, educational, and quarantine programs of the State and Federal Governments and earnestly recommends the appropriation of the funds needed to maintain and, if necessary, to expand them as suggested later in this report. The committee recommends this support only after due consideration of the absolute necessity of holding current governmental expenditures to a minimum.

After careful investigation of the regulatory, research, and educational activities, the committee suggests and recommends:

1. Since the enforcement of quarantine regulations in the United States has undoubtedly been instrumental in preventing long distance spread of the insect in the past, that this activity of the Federal Governments of the United States and Canada, as well as the State and Provincial governments, be supported and encouraged by all agencies and individuals interested in the welfare of American Agriculture. These activities should include: (a) thorough scouting, (b) careful clean-up of isolated infested areas, and (c) maintenance of quarantines.
2. That the extension agencies of the Federal governments of the United States and Canada and of the State and Provincial agricultural colleges, strengthen and coordinate their programs of education relating to the corn borer, extending these to conform with the spread and abundance of the insect and with the increased knowledge gained through research.
3. The entomological investigations now in progress should be continued. The following studies on which material progress already has been made, should be especially stressed: (a) the expedition of parasite introductions and the development of artificial media for mass production of parasites, (b) the development of effective insecticides and their efficient application, (c) evaluation of the effect of environmental factors on the insect's activity.
4. While the development of immune varieties seems unlikely at this time, experiments point clearly to the probable development of high yielding resistant and tolerant varieties of corn which should be an important factor in control. To promote the development of such varieties, the corn breeding programs of the State and Federal governments should be continued and strengthened.
5. Inasmuch as control of the borer, as yet, depends largely upon mechanical means in the hands of growers, it is recommended that research and development work along mechanical lines by the agricultural engineers be continued and be strongly supported by the Federal Government and by the States, with a sincere effort being made to coordinate such activities through the Bureau of Agricultural Engineering. In such work it is recommended that attention should be directed first toward machine types now common on farms, in view of the fact that agriculture cannot easily avail itself of new types of equipment primarily for control until it has used to the best possible advantage the equipment now on farms.

Attention is drawn to the fact that considerable development work has been accomplished and now awaits adoption by the various extension forces and by the manufacturers of farm equipment. It is recommended that the extension forces bear in mind that the better use of equipment now on farms is to be fostered.

The manufacturers are to be commended for their interest and loyal support in corn-borer work to date, and, in spite of the readjustment period, it is hoped that they will continue rapidly to convert development accomplishments into the commercial channels, so that the growers—who must carry the burden of control—will not be handicapped by the latest, practical, mechanical devices not being available to the public.

6. Since the corn borer control practices developed and proposed may change the organization and income of the farm, it is important that the relation of these practices to the entire farm business be determined and recommendations made for specific conditions. Proposals including changes in cropping systems, complete utilization of corn, substitute crops, changes in corn acreages, and labor and equipment costs should be worked out in line with the objective of maximum returns from farming.

7. Continued and further studies should be made on the influence of different borer populations upon; (a) feeding value of corn and the corn plant in different forms, (b) upon the yield of feed nutrients per acre, (c) comparative feeding value due to different methods of harvesting and preparing crop, (d) use and feeding value of substitute crops and (e) the influence of the corn borer and resultant control measures upon the cost of production and the quality of livestock products.

Respectfully submitted,

COMMITTEES

American Association of Economic Entomologists

G. A. DEAN D. J. CAFFREY
L. CAESAR T. J. HEADLEE
J. J. DAVIS

American Society of Agronomy

L. E. CALL J. F. COX
W. L. BURLISON R. M. SALTER
F. D. RICHEY

American Society of Agricultural Engineers

C. O. REED A. L. YOUNG
W. C. HARRINGTON R. B. GRAY
R. D. BARTON

American Farm Economic Association

E. D. HILL J. COKE
C. R. ARNOLD LYNN ROBERTSON
C. L. HOLMES R. R. HUDELSON

American Society of Animal Production

E. W. SHEETS PAUL GERLAUGH
F. G. KING G. A. BROWN
T. B. MORRISON

Voted that the report be accepted and the recommendations adopted.

PRESIDENT J. S. HOUSER: We will now hear the report of the Committee on National Museums. Mr. J. J. Davis stated that he had no specific recommendations to make at this time. The committee is a continuing committee and it does not seem advisable to present a report unless there are definite recommendations which require immediate action.

Voted that the report of Mr. Davis be accepted.

PRESIDENT J. S. HOUSER: We will now hear the report of the committee on Recommendations to the Secretary of Agriculture with Reference to Needs for Foreign Stations to Study Insect Pests, Plant and Animal Diseases Introduced or Likely to be Introduced.

Mr. Herbert Osborn stated that the committee had held no meetings during the year and conditions did not seem to be favorable for making progress at the present time.

Voted that the verbal report be accepted as a report of the committee.

PRESIDENT J. S. HOUSER: We will now hear the report of the subcommittee on Entomological exhibits for the Chicago Century of Progress Exposition.

REPORT OF THE SUB-COMMITTEE ON ENTOMOLOGICAL EXHIBITS CHICAGO CENTURY OF PROGRESS EXPOSITION

There has been no general committee meeting during the past year. Different members of the committee have submitted plans for individual units of the large exhibit originally planned for the Century of Progress Exposition. The management of the Exposition decided that all of these large units should be placed in the agricultural exhibits. Detailed plans have now been submitted to the management of the Century of Progress for the following units:

(1) Introduced Pests.
(2) Spraying, Dusting, Fumigating, Insecticides, Appliances and Equipment.
(3) The Value of Insects to Man.
(4) Mass, Number and Kinds of Insects as Compared with Other Animals.
(5) Insects as Carriers of Plant Diseases.
(6) Insects as Pests of Growing Fruits.
(7) Amount and Kinds of Taxes Collected by Insects.
(8) Household Insects, (Including carpet beetles, termites, bedbugs and clothes moths as typical examples).
(9) Shade Tree and Forest Insects.
(10) Biological Control.

Owing to the general financial depression and its consequent effect on the funds being made available to the Exposition Management, there is considerable uncertainty as to how many of these units can be developed without state or Federal aid. See page 9 of Proceedings. A number of units in the general biological exhibit will use insects as illustrative material, and these to a considerable extent take the place of the larger exhibits which were first planned and some of which may still be used in the general agricultural exhibit.

The management of the Exposition is particularly desirous of help in securing the material for these exhibits and will be glad to make arrangements with anyone who can furnish the material or help to arrange the exhibits whereby any unit of the exhibit can be set up and used during the six months when the Century of Progress Exposition will be open and then returned to the institutions or individuals aiding in the work.

The Committee on Exhibits asks the cooperation of all members of the Association in helping in every way possible to make these exhibits a credit to their profession.

Respectfully submitted,

W. P. FLINT

Mr. W. P. Flint stated that the plans for the Exposition were progressing favorably in spite of present economic conditions. The buildings are going up very rapidly and the management expects to carry through the plans as they were originally laid out.

Voted that the report be accepted.

PRESIDENT J. S. HOUSER: The next report is by the committee on Attendance at the International Congress of Entomologists in Paris in 1932. This report, prepared by O. A. Johannsen, was read by the Secretary.

December 23, 1931.

Mr. A. F. BURGESS,
Greenfield, Mass.

DEAR MR. BURGESS:

In behalf of the Committee appointed last year for the purpose of stimulating interest in the 5th International Congress of Entomology, and for aiding in arranging transportation, I have the honor to submit the following:

The number of favorable answers received in response to the circulars and questionnaires sent out last summer, warrants a continuance of plans for providing transportation to Europe in two groups, one sailing from New York on June 11th, returning to New York Sept. 25th; the other sailing July 1st, and returning Sept. 5th. Provisions are also made for those going directly to Paris without stopping at intermediate points.

Through the kind co-operation of our colleague, Dr. J. C. Bradley, who expects to spend the summer in Europe, the committee has gone farther than originally contemplated in arranging groups for visiting centers of entomological points of interest in other parts of Europe for those who have expressed a wish to travel together.

Respectfully submitted,

F. E. LUTZ
ALBERT HARTZELL
O. A. JOHANNSEN, *Chairman*

Voted that the report be accepted, the committee continued, and that they be thanked for the services rendered thus far. In answer to a number of inquiries that were made concerning the International Congress, Mr. J. C. Bradley presented more detailed information. He also had literature and maps showing the travel routes that were available and the cost of different trips in connection with the Congress. Members of the Association should get in touch with Mr. Johannsen in order to secure the fullest information concerning this important Congress.

PRESIDENT J. S. HOUSER: We will now hear the report of the special committee, consisting of W. A. Price, A. F. Satterthwait and C. R. Cutright, who were appointed to consider the amendments to the Constitution and By-Laws which were proposed at the last annual meeting.

REPORT OF COMMITTEE ON AMENDMENTS TO THE CONSTITUTION AND BY-LAWS

Your committee wishes to recommend the adoption of the appended amendments.

Amend Article 3, Section 1, of the Constitution to read as follows: The officers shall consist of a President, one Vice-President and an additional Vice-President for each Branch or Section, who shall be elected annually, a Board of Trustees of the Permanent Fund and a Secretary who shall be elected for a term of three years, who shall perform the duties customarily incumbent on their respective offices and as defined in the By-Laws. The President and Secretary of the Association, together with three members, one of whom shall be elected annually for a term of three years, shall constitute the Executive Committee, provided also that the retiring President shall retain membership on the Executive Committee for two years after the expiration of his term and the ex-President who next preceded him shall be a member of the Committee for one year. The Executive Committee shall pass on all urgent matters that cannot be deferred until the annual meeting. The President shall not hold office for two consecutive terms. The Board of Trustees of the Permanent Fund shall consist of the President, Secretary and three members at large who shall be elected for terms of three years, so arranged that one member shall be elected annually.

Article 4, to be renumbered and read as follows:

FUNDS

Section 1. The general funds of the Association shall be entered and accounted for in such a manner that the financial condition of each activity can be easily determined. A permanent fund shall be established which shall include all donations, bequests, fees for life membership and such other property or funds as may be added to it by transfer. The principal of this fund shall be invested and shall not be expended without recommendation of the Executive Committee and the approval of the Association at the annual meeting, notice of such action to be given in the call for said meeting. The interest in any year may be used to meet necessary expenses of the Association on approval of the Executive Committee and if not so expended shall be added to the principal.

Re-number Article 4 to read Article 5 and re-number Article 5 to read Article 6.

Amend By-Laws by inserting a Section in Article 2 numbered Section 3, to read as follows: The trustees of the permanent fund shall have charge of the money or other property placed in such fund and shall be authorized to invest it in securities considered legal for trust funds.

Re-number Section 3 to read Section 5.

The last of the amendments proposed at the Cleveland meeting a year ago and reading: "Publication of the Journal of Economic Entomology shall be entrusted to an Editor, an Associate Editor and a Business Manager to be elected annually, and an Advisory Committee of 6 members which latter shall be elected for terms of three years so arranged that two shall be elected annually. The members of this committee shall have an advisory relation to the above stated editorial board," did not meet with favor in the committee.

For the Committee,
A. F. SATTERTHWAIT
C. R. CUTRIGHT

It was voted, after an explanation by Mr. Price concerning the reasons for changing the Constitution and By-Laws, that the different articles be taken up and voted upon separately. In the first section it was voted to make a slight change in the wording in order to prevent misunderstanding, by eliminating the words, "and the Ex-President who next precedes him shall be a member of the committee for one year." With this change the amendments to the Constitution and By-Laws were adopted by the Association with the exception of the amendment to the By-Laws relative to the election of the officers of the Journal. This amendment was disapproved by the committee and its recommendation was sustained by the Association.

The Amended Constitution follows:

AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

(Organized 1899, Incorporated December 29, 1913)

CONSTITUTION

ARTICLE I

Name and Objects

SECTION 1. This association shall be known as the American Association of Economic Entomologists.

SECTION 2. Its object shall be: (1) To discuss new discoveries, to exchange experiences, and to carefully consider the best methods of work in economic entomology; (2) to give opportunity to individual workers of announcing proposed investigations so as to bring out suggestions and avoid unnecessary duplication of work; (3) to suggest when possible, certain lines of investigation upon subjects of general interest; (4) to promote the study and advance the science of entomology; (5) to publish the Journal of Economic Entomology.

ARTICLE II

Membership

SECTION 1. All economic entomologists, horticultural or apiary inspectors, employed by the General or State governments or by the State experiment stations, or by any agricultural or horticultural association, and all teachers of economic entomology in educational institutions and other persons engaged in practical work in economic entomology, may become members.

SECTION 2. The classes of membership shall be active, associate, and foreign. Active membership shall be conferred only on persons who have been trained in entomological work and whose practical experience or published papers have evidenced their ability to conduct original investigations in economic entomology.

SECTION 3. Associate membership may be conferred on persons who have done general or practical work in entomology and who have by published papers or otherwise, given evidence of their attainments in such work.

SECTION 4. Foreign membership shall be honorary and shall apply only to members residing outside of the United States and Canada.

SECTION 5. Associate and foreign members shall not be entitled to hold office or to vote.

SECTION 6. Membership, other than foreign membership, may be conferred at any regular meeting by a two-thirds vote of the members present upon recommendation of the committee on membership, after a regular application endorsed by two active members has been filed with the Secretary.

SECTION 7. Foreign members may be proposed in writing by any active member and their names shall be acted upon by the committee on membership and the Association, as in the case of other members.

SECTION 8. Any member who shall pay to the Association the sum of $100 may be made a life member and shall thereafter be exempt from dues and shall be furnished with the Journal of Economic Entomology without further charge.

ARTICLE III

Officers

Section 1. The officers shall consist of a President, one Vice-President and an additional Vice-President for each Branch or Section, who shall be elected annually, a Board of Trustees of the Permanent Fund and a Secretary who shall be elected for a term of three years, who shall perform the duties customarily incumbent on their respective offices and as defined in the By-Laws. The President and Secretary of the Association, together with three members, one of whom shall be elected annually for a term of three years, shall constitute the Executive Committee, provided also that the retiring President shall retain membership on the Executive Committee for two years after the expiration of his term. The Executive Committee shall pass on all urgent matters that cannot be deferred until the annual meeting. The President shall not hold office for two consecutive terms. The Board of Trustees of the Permanent Fund shall consist of the President, Secretary, and three members at large who shall be elected for terms of three years, so arranged that one member shall be elected annually.

ARTICLE IV

Funds

Section 1. The general funds of the Association shall be entered and accounted for in such a manner that the financial condition of each activity can be easily determined. A permanent fund shall be established which shall include all donations, bequests, fees for life membership and such other property or funds as may be added to it by transfer. The principal of this fund shall be invested and shall not be expended without recommendation of the Executive Committee and the approval of the Association at the annual meeting, notice of such action to be given in the call for said meeting. The interest in any year may be used to meet necessary expenses of the Association on approval of the Executive Committee and if not so expended shall be added to the principal.

ARTICLE V

Annual Meeting—Quorum

SECTION 1. The annual meeting shall be held at such time and place as may be decided upon by the association at the previous annual meeting and special meetings

may be called by order of the Executive Committee. Twenty members shall constitute a quorum for the transaction of business.

ARTICLE VI

Amendments

SECTION 1. All proposed alterations or amendments to this constitution shall be referred to a committee of three at any regular meeting, and after a report from such committee, may be adopted by a two-thirds vote of the members present; Provided: That a written notice of the proposed amendment has been sent to every active member of the association at least one month prior to the date of action.

BY-LAWS

ARTICLE I

Of Members

SECTION 1. The classes of members are defined in the constitution as are their rights to vote or hold office. Members of all kinds have equal privileges as to presentation of papers and in scientific discussions at the regular meetings, and may, by permission of the presiding officer, speak on business questions before the association.

SECTION 2. All members in good standing have equal rights to the publications of the association or to any publications controlled or distributed by the association.

ARTICLE II

Of Officers and Their Duties

SECTION 1. It shall be the duty of the president, in addition to the ordinary duties of the presiding officer, to prepare an address, to be delivered at the annual meeting over which he presides. He shall also appoint the necessary committees at the first session of the annual meeting.

SECTION 2. It shall be the duty of the secretary to make the necessary arrangements for the meetings of the association and keep a record of the proceedings for publication, to provide the necessary stationery and attend to the general correspondence. He shall collect moneys due, pay all bills incurred by the association, submit a report at each annual meeting, and perform such other duties as may be delegated to him.

SECTION 3. The Trustees of the permanent fund shall have charge of the money or other property placed in such fund and shall be authorized to invest it in securities considered legal for trust funds.

SECTION 4. The publication of the Journal of Economic Entomology shall be entrusted to an Editor, an Associate Editor and a Business Manager nominated by an Advisory Committee of six members, which latter shall be elected for terms of three years so arranged that two shall be elected annually. The members of this committee shall have an advisory relation to the above constituted Editorial Board.

SECTION 5. All officers and standing committees unless otherwise provided for shall be elected by ballot after recommendations have been made by a nominating committee.

ARTICLE III

Dues

SECTION 1. The annual dues of members shall be one dollar and fifty cents, which shall be payable in advance. No dues shall be payable from foreign members. Annual dues shall not include subscription to the Journal of Economic Entomology.

ARTICLE IV

Of Meetings

SECTION 1. Notice of the time and place of meetings shall be sent for publication to all American entomological periodicals. The proceedings shall be published as decided by the association.

SECTION 2. Special meetings shall be called as provided for in the constitution, and notice of such meeting shall be given by the Secretary by mailing to each active member a formal notification of the time and place of the meeting at least two weeks before the date fixed in the notice. The notice shall state the reason for such meeting, and shall specify the business to be transacted, and no other business shall be transacted.

SECTION 3. The order of business at regular meetings shall be, at the first session:

1. Calling the meeting to order by the president.
2. Reports of officers.
3. Reports of committees.
4. Appointments of temporary committees.
5. Written business communications.
6. Verbal business communications.
7. New business.
8. Program of papers and discussions.
9. Adjournment.

At the following sessions:

10. Program of papers and discussions.
    Business can only be introduced at these sessions by vote of the association.

At the last regular session:

11. Program of papers and discussions.
12. Reports of appointed committees.
13. Miscellaneous business.
14. Election of officers.
15. Fixing time and place of next meeting.
16. Adjournment.

ARTICLE V

Amendments to By-Laws

SECTION 1. Changes in these by-laws may be made by a two-thirds vote at any regular meeting: Provided, notice in writing of the proposed amendment be sent to every active member at least two weeks before the date of the meeting, at which time it can come up for consideration.

Approved by the Association
Dec. 31, 1931.

PROFESSOR J. S. HOUSER: We will now hear the report of the Trustees of the Permanent Fund.

REPORT OF THE BOARD OF TRUSTEES OF THE PERMANENT FUND

During the past year funds have been withdrawn from the savings accounts and four Federal Farm Loan Bonds have been purchased. By authority of the Executive Committee there was transferred to this fund $900 from the Association Fund and $600 from the Journal Fund. These amounts, together with accrued interest, have been added during the year. The fund has been audited and the report of White, Hickox & Company, Certified Public Accountants, will be found with the other financial transactions of the Association.

Respectfully submitted,

A. F. BURGESS, *Chairman*
C. W. COLLINS
E. N. CORY
J. S. HOUSER
C. L. MARLATT
Committee

By a vote of the Association the report was adopted.

PRESIDENT J. S. HOUSER: We will now hear a report of the special committee on Program.

REPORT OF SPECIAL COMMITTEE ON PROGRAM

At the Cleveland meeting the Association voted that the President appoint a special committee to program the next annual meeting.

President Houser appointed W. C. O'Kane, T. J. Headlee and the Secretary to take charge of the matter. After considerable correspondence a plan was adopted by the committee and an outline was published in the August number of the Journal of Economic Entomology.

Invitations to present papers on special subjects were accepted by Prof. W. B. Herms and Mr. Lee A. Strong. Dr. H. A. Hawkins was invited to present a paper by President Houser, and Prof. O'Kane was asked to read a paper by the other members of the Committee.

The program for the Joint Meeting with the Cotton States Branch was prepared by the Secretary of the Branch, Mr. O. I. Snapp, and the programs for the Section meetings were prepared by the Secretaries of the Sections.

After the titles of papers were received the program was prepared. It is arranged so that there will be approximately one-half of the time available for discussion of the papers presented.

(Signed) W. C. O'KANE
THOMAS J. HEADLEE
A. F. BURGESS, *Chairman*
Special Committee on Program

Voted that the report be accepted.

PRESIDENT J. S. HOUSER: The Nominating Committee has been appointed as follows: G. A. Dean, Chairman, W. B. Herms and J. R. Parker.

Committee on Resolutions: M. D. Leonard, T. H. Frison and K. C. Sullivan.

L. B. Smith of the Membership Committee is unable to attend this meeting and E. L. Chambers has been asked to serve in his place.

FINAL BUSINESS SESSION

PRESIDENT J. S. HOUSER: I will call for the report of the committee on Resolutions.

Voted that the report be adopted.

PRESIDENT J. S. HOUSER: We will now listen to the report of the committee on Membership.

REPORT OF THE MEMBERSHIP COMMITTEE

Your committee on membership submits for your consideration the following report.

(1) That the following be reinstated as associate members.

Davis, Irving W.	Moreland, R. W.
Emery, W. T.	Watson, R. J.

(2) That the following 30 associate members be advanced to active membership:

Annand, P. N.	Clark, S. W.	Lamiman, J. F.
Arant, F. S.	Dove, W. E.	Mail, G. Allen
Anderson, W. E.	Dietrich, Henry	Marvin, G. E.
Anderson, E. J.	Farrar, M. D.	Smythe, E. G.
Breakey, C. P.	Henderson, W. W.	Sleesman, J. P.
Brewer, Erle	Hobbs, Edward	Schaffner, J. V.
Bynum, E. K.	Johnson, J. P.	Smith, G. L.
Cartwright, O. L.	Johnston, H. G.	Sherman III, Franklin
Cushing, E. C.	Kislanko, J. P.	Taylor, R. L.
Chamberlin, W. J.	Light, S. F.	Wells, R. W.

(3) That the following 85 candidates be elected to Associate membership.

Adams, J. Alfred	Donohoe, Haber C.	Hoskins, Wm. M.
Balzer, August I.	Durham, Wallace	Hoyt, Avery S.
Baker, Wm. W.	Ellenwood, W. W.	Hunt, Wm. T.
Bunn, Ralph	Fahey, Jack E.	Irvin, F. V.
Burtch, Lewis A.	Goseco, Federico P.	Janes, Melvin J.
Brummitt, Sidney C.	Grant, Wilbur A.	Jameson, John H.
Bushnell, Ralph Judson	Green, G. D.	Jenkins, Lee
Curl, Chester L.	Hamner, Oscar H.	Jorgenson, D. D.
Callenbach, John A., Jr.	Hatten, M. J.	Kagy, J. Franklin
Carroll, Francis Edward	Hatcher, R. F.	Kearns, Clyde W.
Clement, Robert Lawrence	Hixson, Homer	Lehman, Russell S.
Dawson, J. Cart	Hodson, Alexander C.	Lilly, John H.
Davis, L. Reid	Holdridge, Abby	Loding, C. P.
Dawsey, Lynn H.	Hopkins, C. O.	Lott, Earl
Dobbins, Traber N.	Horsfall, Wm. R.	Lopp, O. Vernon

Madden, Archie H.
Mayer, Lionel A.
McDonald, R. E.
Meymarian, A. T.
Michelbacher, A. E.
Monk, J. W.
Miller, A. C.
Murray, Charles W.
Oertel, E.
Padget, L. J.
Pearson, Allen M.
Parr, Thad J.
Peet, Chas. H.
Pepper, James H.
Pierce, Wm. Clinton
Piller, A. L.
Plumb, George Henry
Preston, Roger Lee
Price, L. L.
Richmond, R. G.
Rainwater, Clyde F.
Romney, V. E.
Sakimura, Kay
Shaw, J. Gilbert
Simmons, Samuel W.
Shopp, Ralph
Simonton, William A.
Slocum, Burl A.
Stitt, Lloyd L.
Sullivan, Wm. N.
Tate, H. D.
Thurber, George A.
Vanderford, H. T.
Van Horn, Clair
Vinzant, M. G.
Watts, J. G.
Watson, S. A.
Warren, Allen J.
Williamson, Amis L.
Woodrow, A. W.

(4) That the resignation of the following active members be accepted.

Coe, W. R. Miller, A. E.

(5) That the resignations of the following Associate members be accepted.

Brinley, F. J.
Elmore, L. E.
Christenson, Mrs. R. O. (Verda Doudle)
McDonnell, C. C.
Garthside, Stanley
Haldaway, F. G.
Maier, E. A.
Mason, P. W.
Thomason, H. L.
Sazama, F. B.

(6) In order to facilitate the work of future membership committees; and to make it possible to promote Associate members to Active membership in a more equitable way, your Committee further recommends that the membership committee send out a form letter next year to all Associate members and as often thereafter as necessary in order to secure sufficient information to enable the committee to pass on their qualifications for Active membership. This information to be supplemented as in the past by recommendations from Active members. By all means this information should be secured early in the year; and that this information be recorded and kept in a permanent file: this information to be transferred from one membership Committee to the next and become the permanent property of the Association.

(Signed) E. L. CHAMBERS
JOHN E. DUDLEY, JR.
S. W. BILSING, *Chairman*

Voted that the report be adopted.

PRESIDENT J. S. HOUSER: I will now call for a report of the committee on Nomenclature which was not read at the opening session.

REPORT OF COMMITTEE ON NOMENCLATURE

During the past year your Committee submitted a list of 306 names to the members of the Association for their approval, in accordance with instructions received at the last regular meeting. Of these names 270 were approved.

The Committee has prepared a complete list of all common names so far approved by this Association, 879 in number, and with the sanction of the Executive Committee, the complete list was published in the Journal of Economic Entomology, Vol. 24, No. 6, p. 1273–1310. This list will also be published as a separate and offered for sale by the Association.

The Committee has received so few nominations for additional names during the

past year that it recommends that no list be submitted to the membership for approval until 1932.

J. A. HYSLOP, *Chairman*
E. O. ESSIG
F. C. BISHOPP
H. B. HUNGERFORD
H. G. CRAWFORD
Committee

Voted that the report of the committee be adopted.

PRESIDENT J. S. HOUSER: In the absence of the Chairman of the committee I will now read a report on the organization of a National Biological Society.

REPORT OF COMMITTEE ON THE ORGANIZATION OF A NATIONAL BIOLOGICAL SOCIETY

Your committee appointed to consider the advisability of organizing a National Biological Society inside of which the various special biological entities may form distinct groups, begs to report as follows:

The movement for a National Biological Society was initiated by the geneticists. As now constituted, the group of geneticists is a loose one formed by workers among the botanists, zoologists, ecologists, et al. The geneticists are not satisfied with this indefinite, cross-section sort of membership for their organization. They desire a clean-cut, independent group or section known as the Genetics Society to compare with the Botanical or Zoological Society. The geneticists therefore, in order to attain their desire for such a society thought that it would be best to organize, first, a National Biological Society within which they could then form an independent Genetics Association.

It now appears that the geneticists have evolved another and perhaps less cumbersome plan for their organization. Consequently the movement for the formation of a National Biological Society has been dropped. Your committee, therefore, reports that it has nothing to recommend and respectfully asks to be discharged.

DWIGHT M. DELONG
E. A. BACK
GLENN W. HERRICK, *Chairman*

Voted that the report be accepted and the committee discharged.

PRESIDENT J. S. HOUSER: We will now hear the report of the Committee on Nominations.

REPORT OF COMMITTEE ON NOMINATIONS

President: W. P. Flint.
First Vive-President: H. J. Quayle.
Vice-Presidents: (Pacific Slope Branch)—Geo. M. List.
(Cotton States Branch)—R. W. Harned.
(Eastern Branch)—L. M. Peairs.
(Section of Plant Quarantine and Inspection)—W. A. Price.
(Section of Apiculture)—E. F. Phillips.
Secretary: A. J. Bourne.

STANDING COMMITTEES

Executive Committee for 3 years:
E. N. Cory.
Two years—J. S. Houser
Two years—Don. C. Mote

Membership Committee for 3 years:
Alvah Peterson.

Advisory Board, Journal of Economic Entomology for 3 years:
H. S. Smith.
A. G. Ruggles.

Committee on National Museum for 3 years:
C. P. Alexander.
E. C. Van Dyke.

Committee on Research Work on Control of the European Corn Borer for 5 years:
Lawson Caesar.

Board of Trustees for Permanent Fund for 3 years:
H. B. Hungerford.

Councillors for the American Association for the Advancement of Science.
W. E. Hinds.
R. N. Harned.

Trustees for Crop Protection Institute for 3 years:
C. H. Richardson.

Representatives on Council of Union of American Biological Societies:
F. C. Bishopp.
C. R. Crosby.

Committee on Investigations on Codling Moth for 3 years:
B. A. Porter.
J. S. Houser.

GEO. A. DEAN
W. B. HERMS
J. R. PARKER
Committee

It was moved and seconded that the Secretary be instructed to cast a ballot for each of the persons named in the report. The ballot was cast and the nominees were declared elected.

PRESIDENT J. S. HOUSER: I will request Herbert Osborn and E. P. Felt to conduct our next President to the chair. President elect Flint was brought to the platform and notified of his election by President Houser, presented with the Association gavel and with best wishes for a successful administration.

PRESIDENT W. P. FLINT: I do not feel that I can make a speech at this time. It has always seemed to me that the honor of being elected President of this Association was the highest honor that any man in economic entomology could receive, because he receives it from his fellows who know his work and usually know what he is capable of

doing. I will endeavor to fill this office to the best of my ability during the coming year and if my administration proves successful it will be largely because of the help that I receive from the members of the Association. Applause.

PRESIDENT W. P. FLINT. We will now hear the report of the Advisory Committee of the Journal of Economic Entomology, whose duty it is to nominate the officers of the JOURNAL.

NOMINATION OF JOURNAL OFFICERS BY ADVISORY COMMITTEE

Editor, E. P. Felt.
Associate Editor, D. M. DeLong.
Business Manager, A. I. Bourne.

L. A. STEARNS
G. M. BENTLEY
Committee

Voted that the report be adopted.

Secretary Burgess read two communications,—one from the Century of Progress International Exposition, inviting the Association to hold its meeting in Chicago in the summer of 1933, and the other from the American Phytopathological Society relative to the action taken by that Society in connection with affiliating with the International Union of Biological Sciences.

By vote of the Association these two matters were referred to the Executive Committee.

Invitations were extended by C. I. Bliss to visit the Bureau of Entomology Laboratory near New Orleans, and by W. E. Hinds to pay a visit to the State University at Baton Rouge.

W. C. O'Kane suggested that the item on the program calling for discussion of the President's address be omitted in the program of the next meeting.

SECRETARY BURGESS: The Constitution and By-Laws have been amended several times in the last few years. I think it would be advisable to have them reprinted so that a correct copy will be available. It was suggested by Mr. E. P. Felt that this might be printed in the Journal and a number of reprints prepared.

It was voted that this be done.

Voted that the fixing of the time and place of the next annual meeting be referred to the Executive Committee.

Adjournment was then voted, which closed the transactions of the 44th annual meeting.

PART II. ADDRESSES, PAPERS AND DISCUSSIONS

The session for the presentation of technical papers convened immediately following the business session Tuesday morning December 29, with Vice-President W. E. Hinds in the Chair.

VICE-PRESIDENT W. E. HINDS: We will now hear the address of the President J. S. Houser.

SOME PROBLEMS IN ECONOMIC ENTOMOLOGY

By J. S. HOUSER

ABSTRACT

One of the first problems which confronts the economic entomologist is that of choosing wisely his field of activity. Some problems have been overworked and others have been seriously neglected. Considerable judgment should be exercised in determining the attitude one should take toward a newly introduced insect. A present need is for more basic, fundamental research, but this line of endeavor is not likely to reach its highest state of development until financial support is placed upon a more stable foundation, possibly through the avenue of endowments. Two other problems are outstanding: (1) Improvement in experimental technique, particularly as it applies to field plot work, and (2) a more perfect correlation of entomological activities within the area served by the members of this Association.

It has been my great privilege to attend nearly half of the previous meetings of this Association and to hear the President deliver the annual message. Sometimes the address was historical in nature and dealt with our profession, our Association, or with the personal endeavors of the speaker; while on other occasions it was prophetic and inspirational. Again it dealt, in part at least, in a frank criticism of existing conditions as he viewed them, which, in turn, was accompanied with an expression of his notions concerning the adjustments that should be made. Other addresses were concerned with an inquiry into things entomological as they were at that time.

The subject I have chosen most nearly fits into the last named group and, as may be expected, since my personal experience has dealt almost entirely with the investigational phases of entomology, it will be concerned more specifically with the research aspects of our profession.

Last year President Sherman discussed "Census Taking in Entomology." He implored us not only to learn to know all the insects but to inquire intimately into the personal affairs of each species. It seemed logical that such a discussion should be followed this year by an inventory of our knowledge of some of the outstanding problems with

which we, as economic entomologists, have to deal. Moreover, as the months of the year progressed, it became evident that 1931 was to be outstanding in insect damage in many parts of America. Almost forgotten pests returned and old ones took on new roles; many of those we have always with us redoubled their efforts and entirely new ones appeared.

In view of these facts may we not well afford at this time to review the situation in an attempt to discover whether we, as entomologists, are measuring up to the conditions as well as we might—are we fully efficient? Do we click? Are we able to get the grease on the squeak?

Of course, we all admit we have made progress along some lines. For example, we have learned not to "view with alarm" and to paint a dour picture of every insect as if it were a devastating varmint which threatened to blast the very foundations from some basic crop. We have learned to be modest and not to "point with pride" to the fact that had it not been for our timely intervention, commodities to the value of countless millions would have been reduced to the status of mere Hexapod fodder. In California, entomology actually has reached such a state of perfection that some workers now purchase insect life insurance.

Our successes, however, may cause us to revert to the complacency of our nursery days when "We put in our thumb and pull out a plum and say what a big, big boy am I." Stated in somewhat different terms, the inquiry I wish to pursue is—Just how big are we and, if we are not big enough, by what means may we become bigger? I know of no better way to accomplish this than to look squarely at things as they are and the way we are approaching and executing our work. Let us inquire first of all into the manner of selecting the field of activity we wish to pursue.

Choosing the Problem. A fairly safe criterion for the economic entomologist to follow, in choosing the projects upon which he is to concentrate, is to determine as accurately as possible the outstanding needs of his clientele, and herein considerable judgment must be exercised. It is fortunate if this need is accompanied by popular demand, for under such conditions it is far easier to secure adequate financial support. If a newly introduced pest has not yet caused perceptible damage in its new home, the need for entomological help is not apparent to the layman. Then, indeed, not only may the entomologist find it difficult to secure adequate funds, but he may even discover that the public is hostile to his activities, particularly if his efforts are of a nature to cause inconvenience. On the other hand, popular demand is not always a safe rule to follow, since it may emanate from an active group with local

interests; and to expend one's major effort on such a project would result in injustice to some more worthy need of wider application.

One of the most treacherous trails that the entomologist travels is that of a newly introduced insect, because it is difficult to judge exactly what policy to follow. He may expect serious damage and thus launch a vigorous program of research to meet the situation, only to find, after he has expended money and effort, that he has misjudged the seriousness of the problem and that his resources might well have been expended along some other line. Again, it is an equally serious mistake to underemphasize a situation in its incipient stages and thus allow something really serious in nature to get beyond control. Will I cause embarrassment if I ask, "Have we misjudged the European corn borer, the Japanese beetle, the Oriental fruit moth, and perhaps others; and if we have misjudged, in what direction have we erred?"

A tendency which must be guarded against is that of selecting problems on the basis of their purely personal appeal instead of on the basis of the real need of investigation. We like to be the first to occupy new fields. We like to be first to bring to light new economic pests; we like bibliographies which follow the chronological arrangement, for if we have been first, our names then head the list. However, the entomologist who allows himself to be dominated by this tendency is a selfish man, and very few of these have found an abiding place in the annals of entomological achievement, or more particularly in the goodwill and respect of the public which, by means of our science, we are committed to serve.

The foregoing discussion, however, does not completely satisfy, since I am unable to decide why we devote so much attention to some problems and neglect others. Let us consider first some of the older and much worked ones which I will designate as:

Some Threadbare, yet Unsolved Problems. There is little doubt that the codling moth has received, during the last quarter of a century, more attention than any other economic pest in America; yet after many years of investigation, where do we stand today on this problem? The evidence indicates that it is still a lively subject for research. For example, the last report issued by the Federal Office of Experiment Stations on the classified projects of the state stations, indicates that seventeen states consider the problem incomplete and three others list apple insects or apple-spraying projects in which, beyond doubt, codling moth is included. To this number we must add the projects of the Bureau of Entomology, those of the Dominion of Canada and its Provinces, as well as those of the commercial entomologists. The mass

of American literature on this subject is very large. I was astonished, as perhaps you, too, will be when I state that, upon consulting the four volumes of the Index of American Entomology, I found that one thousand and thirty-four papers had been published between 1905 and 1924, and this list does not include farm paper articles. Judging from the authors to whom these papers are credited, most of the entomologists went solo to the fray and pitted their individual strength against the adversary; however, some went in pairs, and occasionally even a trio would sally forth. It would be ungracious, indeed, to maintain that the entomologists have battled lone handed, for I note that we have had as our allies horticulturists and pathologists as well as Station directors, who have contributed articles on the subject.

When one considers everything that has been done and is being done in an attempt to develop a satisfactory control for this insect, at least one fact is outstanding; namely, that this is a very durable bug. With apologies to the Systematists and to the Committee on Common Names, I have decided to transgress on the sacred fields of both and to propose an entirely new name which, to my notion, is a more appropriate one—The Coddled Moth, *Carpocapsa pomonella durabalis* Houser.

In fairness to entomological research and in rebuttal of the implications I have made, it must be admitted that as time has passed the codling moth problem has shifted. A resistant strain of the insect has appeared; the public has become more critical of the quality of fruit; and health officials have made us no end of trouble by insisting that, when our bug-killing job is done, we leave no more than the faintest trace of evidence of the weapons we have employed. Our alibi, however, is incomplete and we are led to wonder if a considerable part of the work we have done really merits the name of research. Had we not better designate some of it as re-searching? By this I mean, may we not have been traveling the beaten path with the hope of salvaging from the ground covered by some previous worker something of value that has been overlooked? I agree with an article by Dean Freeman of Minnesota which appeared in an issue of Science in March, 1929, wherein research is likened to the operation of a mine, in that we may have been spending far too much effort in merely enlarging the hole started by some other worker and far too little in digging deeper for richer ore of greater purity and value. Some of the outstanding needs of the codling moth problem today is an insecticide more potent than arsenate of lead—one that will eliminate the problem of "stings"—and the development of a technique which will insure more perfect and reliable timing of sprays.

Other needs might be enumerated; among these is the perfection of experimental procedure, but of this I will speak a little later.

Although codling moth seems to have occupied the spotlight in the attention of entomologists during the past quarter of a century, other pests have had their share of publicity. I find, for example, in referring to the Index, that between 1905 and 1929, the San Jose scale rated eight hundred and eighty-one papers and the cotton boll weevil six hundred and fifty-nine. However, since 1914 interest in the San Jose scale seems to have slumped. For the ten-year period previous to that date, an average of 62.1 papers per year was required to hold the insect in check, but during the remaining fifteen years, only 17.3 papers per year were deemed necessary. Two entomologists, in a joint paper published during the latter period, näively admit that since the general application of effective control measures to the orchards and nurseries of their state, the insect is no longer considered a problem of importance. Someone should call a conference to study the technique followed in that particular state, committees should be appointed, and a joint report submitted, because more recently I find other entomologists admitting that in their states this resourceful insect is staging a healthy comeback.

By reason of the law of the attraction of opposites for each other, I now pass to the next phase of my subject:

Some Neglected and Unsolved Problems. One of the questions debated at the last meeting of the North Central States Entomologists was, "Are Entomologists Becoming too Insecticide Minded?" The affirmative won the argument. There is no doubt that some phases of the insecticide problem have been well worked and, as it is commonly conceived, this topic might have been discussed with the immediately preceding threadbare group. The volume of the work up to the present time, however, has been concerned almost wholly with whether a given material does or does not kill. Very few have attempted to determine the underlying reasons for the result secured. Notable contributions along this line have been made by Shafer, Moore and Graham, McIndoo, De Ong, Knight, Richardson, Roark, Smith, Sheppard, Griffin, Tattersfield, O'Kane, and others. However, I will venture to assert that if a portion of what we have spent in testing materials had been used in a search for the fundamental reasons involved in their performance, we might now have available formulae to which any material of suspected insecticidal efficiency might be fitted and thus an indication of its value determined. A start already has been made. Complete success, however, is almost beyond the realm of possibility until we know more

than we do now concerning the physiology, morphology, and chemistry of insects, as well as have an enlarged understanding of other related factors. It is an expensive and time consuming task to determine definitely, by means of the procedure now employed, the limits of performance of any one material. One season's work is not sufficient, particularly if the problem is concerned with plants growing out of doors, since a result obtained under the conditions prevailing one year may be reversed the year following under another set of seasonal influences.

A healthful aspect of the insecticide problem exists, in that many corporations are now sponsoring research along this line and not a few are willing that the investigator employed devote at least some of his energy to research which has not immediate prospect of financial returns.

A classical example of the neglected problem, particularly in areas in America where grass is an item in crop rotations, is that of the white grubs and wireworms. Flint and Metcalf estimate the annual loss caused by insects to hay, corn, and potatoes at nearly $417,000,000 per year. White grubs and wireworms are responsible in no small way for this staggering waste; yet what is being done to meet the situation? Compare this loss with that to the apple crop—a little over $21,000,000 per year, or a ratio of nineteen to one. In the List of Projects formerly referred to, I find two states are working on white grubs and six on wireworms; while three others list soil or subterranean insects in which the two insects under consideration may or may not be included.

The losses caused by both of these insects for the most part are not spectacular—indeed, in many instances, they are precisely the opposite and frequently pass unnoticed. Thus, the outside demand for research pertaining to them is not pressing. In the second place, the work performed in the past has indicated that to barely approach an adequate solution is a task involving many years of patient effort. The single fact that, as a rule, three years or more are required to complete the life cycle injects into the problem the long time element in no uncertain manner.

Still another obstruction involved in the problem is the great difficulty experienced in securing the data pertaining to the insects themselves that precision seems to demand, because they lead a subterranean existence during the greater part of the life cycle. Any scheme devised thus far is not without its weaknesses, since there is likely to enter into the situation elements of unnaturalness or disturbance to such an extent that the results secured may not be dependable.

Concomitant with all this is the fact that for the most part entomological research leads a more or less hazardous existence in so far as financial support is concerned, since appropriations, as a rule, are made on a one- or two-year basis, and one never knows just what to expect in the way of future support. The tendency, therefore, is to select projects for which there is a pressing demand and which promise early returns. When so much is said at the present time concerning the desirability of placing agriculture on a permanent basis, might not we as entomologists look a little farther into the future than we are accustomed to doing and begin to call attention to the desirability of placing our research on a more stable financial foundation through the avenue of endowments? If provision could be made for even a few of the difficult, neglected problems, which, because of their nature, are poor sellers to finance committees and require years for solution, a very decided forward step would have been made.

How fortunate it would be if an institution for entomological research similar to the Boyce-Thompson Institute for Plant Research could be brought into being. This thought suggests the next topic I wish to consider.

THE NEED FOR FUNDAMENTAL RESEARCH. If an institute in entomology could be established, wholly removed from the applied aspects of the subject except in a merely incidental way, no one can foretell how many doors would be unlocked upon which we beat helplessly at the present time.

To what better purpose could the permanent fund which this Association has accumulated, largely through the business sagacity of our Secretary, Mr. Burgess, be used than to let it serve as a nucleus for such an endowment. The fact that we have builded such a fund should serve as a means of approach to men of wealth who would be willing to contribute liberally. The goal is not an impossible one. It has been accomplished in the past and it can be reached again.

All research, I am told, is fundamental and that which at the time seems beyond the realm of practical application, easily may resolve itself into something highly useful. It may be wasted effort to discuss with this group the need for research of this character, great as that need seems, for, no doubt, every one present who has conducted investigations with insect control sooner or later has come face to face with one or more of the closed doors. We may secure a result for which there seems no logical explanation, and yet had we been able to interpret all the factors which have contributed to the result, an analysis would have been simple. It is to these contributing factors that the term "funda-

mental" may be ascribed. We may liken them to the springs, rivulets, creeks, and rivers that make the master river, each of which contributes some definite part. It is only after we have laboriously surveyed such a system in its entirety that we are able to understand, for example, why the water in the master river is soft to a certain point and then suddenly becomes hard. Our survey shows that a tributary high in alkali has entered the main stream at the point where our sample of water was taken. Later, we find the water in the main river becomes softer and at the same time much cooler. This is easily explained when we note that somewhat above the point at which we have made this discovery, we find a large stream entering the main channel which has arisen from some nearby snow-capped mountains.

Because of the demand for an early solution of local insect problems, many entomologists find themselves unable to pursue the more obscure aspects of their investigations and are forced to adopt an empirical policy of procedure, hoping that by good chance an effective control will be developed. Much of the work in the past has been conducted in this manner and, because of necessity, the future will see a certain amount of work of this character under way. A hopeful sign, however, is that each year greater numbers of investigators are finding the opportunity to go farther afield, to inquire into the principles underlying their projects, to explore more deeply into the minutia which, when combined, make the completed whole. This is good, but in our eagerness to glean the last possible bit of information concerning some obscure rivulet in the wilderness aspects of our problem, we economic entomologists should remember that it is possible to go too far afield and thus dissipate our energies to the point where we may fail in that which we originally set out to accomplish.

An exceedingly useful purpose to which fundamental knowledge may be put is in forecasting insect behavior, particularly as it applies to pests of major importance. Although there may never come a time when we will be able to forecast with absolute assurance, it is certain that we will not be able to foretell with any certainty whatsoever, unless we have a fairly definite knowledge of the complex which contributes to or mitigates against insect welfare. Many specific examples might be given as illustrative of this point, but I will be content with one.

In the muck lands of one county in Ohio, onion maggot in 1928 cost the growers a half million dollars. The demand for help was so insistent that, the year following, a project dealing with this insect was started. As one part of the program we imported Compton's formula

from Illinois for trial under Ohio conditions. During the three years the work has been under way, onion maggot has never caused significant losses in this area. We found, as has Compton and others, that oil applied to onions causes slight damage and, as a result, since the checks were not injured by maggot, they have consistently out-yielded the sprayed plots regardless of the formula used. We feel confident that had maggot been abundant, the difference would have been striking in the other direction—provided, of course, that oil combinations perform as well in Ohio as they do in Illinois. As we interpret the needs of this problem, it is just as important that we qualify to designate in advance of the spraying season those years when treatment is needless as it is to devise control measures for use in seasons of maggot abundance.

Experimental Technique. Another problem in economic entomology in which there is much need for improvement is the development of dependable experimental technique, particularly as it applies to field plot experiments. In other words, experiments should be inaugurated to determine the proper methods of experimentation. The workers in plant groups are far in advance of the entomologists in this respect, but their problem is much less involved than ours. Not only do we have to contend with all the difficulties the plant men encounter but, in addition, we must fit into the situation the insect with all its complexities.

Permit me by way of example to refer again to the codling moth, since many of this group have had experience with this insect. Should I ask for an opinion of what constitutes the ideal as to plot size and arrangement, the proper system of record taking, etc., it is possible that as many different answers would be received as there were workers reporting. Is it not possible under proper procedure to secure specific information on this point and would not such data be a better guide than mere unsubstantiated opinions? To be sure we might not be able on all occasions to follow in all its details the ideal plan, if such could be evolved, but the data on which the model plan would rest could be utilized in compensating, in part at least, for such defects. May not differences in experimental procedure account in part for the variation in results that are obtained in work with this insect?

It cannot be successfully maintained that a common rule would apply for all insects of economic importance, but general plans could be formulated for use with each of the major pests. In brief, it can be stated with assurance, that a technique should be followed which conforms to biometric principles in order that the results obtained may be subjected to statistical analysis.

It would seem that standardization of the major aspects of experimental technique as applied to entomological research might be accomplished most speedily through more perfect cooperation between the workers of allied projects. This thought leads me to the final problem in economic entomology which I wish to discuss.

THE NEED OF CORRELATION IN ENTOMOLOGICAL ACTIVITIES. A part of the thought I wish to present may be expressed by relating a bit of personal experience. Some years since, shortly before submitting a manuscript for publication, it developed in the course of a conference with a neighboring entomologist that he also was about to publish on the same subject. We found, in comparing notes, that we differed in some of the essential details. Furthermore, both had data which the other desired to include in his bulletin. It was decided that each should withhold publication for another year. In the meantime, additional work was done in each state which completely eliminated the points of difference in question. At the end of the year all the data were combined in one manuscript which was issued as two separate bulletins, each entomologist taking authorship in his own state but giving his neighbor credit for his part in the enterprise.

The branch meetings of this Association, since the problems discussed are usually of common interest, are accomplishing much in the way of fostering cooperation. The occasional more general conferences concerning such outstanding problems as European corn borer, codling moth, Oriental fruit moth, and others are likewise tending to correlate the activities of the several agencies that are particularly concerned. However, many of the entomologists in the states, as well as many in the Federal Government, feel that there is still much to be gained in more closely correlating the activities of these two great groups, and to these groups may be added the Dominion and Provincial workers and the rapidly increasing number of commercial entomologists. There seems little excuse, save under very exceptional conditions, for two or more agencies to work on the same problem under identical conditions, each wholly independent of the other.

The past season of unusual insect activity has demonstrated fully that, instead of our profession being over crowded, there is in reality a dearth of entomologists for the work at hand and that every effort should be made to plan our work and utilize our energies to the best possible advantage.

VICE-PRESIDENT W. E. HINDS: The address of the President is now open for discussion.

Mr. W. C. O'KANE: One of the surest tributes that could be paid to a Presidential Address such as this one is the fact that the author of it has said about all that could be said on the subject and has said it well. We have had a good many Presidential Addresses in the last twenty years which have, in one way or another, summed up the present status of economic entomology. But I for one feel that we have had none that is closer to the facts, more concisely expressed, more logical and worth while listening to and taken to heart than President Houser's address.

VICE-PRESIDENT W. E. HINDS: Apparently Professor Houser hasn't raised a subject that will stimulate controversy particularly.

SECRETARY A. F. BURGESS: Mr. Chairman, it seems to me that this address has covered such a wide field on such important matters that it is a thing that most of the members would like to read and think about and digest. I think President Houser has brought together a lot of very valuable information and good constructive thoughts, but it is most difficult to discuss those things without considering them fully, because they are most important.

Mr. E. P. FELT: Mr. Chairman, I want to endorse the expressions of my precedessors in discussing this paper. I consider Professor Houser's address has been an exceedingly good and comprehensive one. I was greatly pleased, perhaps because I am an editor, that he should go to the Index of Economic Entomology for some of the data. It would have pleased me more if he had worked out a literary exponent, so to speak, which could be used in judging of the destructiveness of various insects. I have in the past, in a general way, at least, turned to some of those records, and they indicate in a broad way the economic status of an insect during certain periods. There is another question that comes up in connection with this, and that is: What is the value of a great deal of the literature in actually bringing about insect control? There comes a period in the development, particularly of a new insect, when we have a large amount of literature, some of it constructive and valuable, some not so good.

I think that from the standpoint of professional economic entomologists we might occasionally go back to some of the bibliographies, look them over critically, not necessarily looking for our own articles though occasionally we might do that, and then ask ourselves: What is it all about and what has all that literature accomplished?

Adjournment 12:35 p. m.

Tuesday Afternoon Session, December 29

The session convened at 2:00 p. m., President J. S. Houser presiding.

PRESIDENT J. S. HOUSER: The afternoon session will now come to order.

The first item is a paper by E. P. Felt and S. W. Bromley.

OBSERVATIONS ON SHADE TREE INSECTS

By E. P. FELT and S. W. BROMLEY, *Bartlett Tree Research Laboratories, Stamford, Conn.*

ABSTRACT

There has been widespread insect injury to shade trees the past season in the northeastern United States. Three introduced pests—the elm leaf beetle, (*Galerucella xanthomelaena*), the Japanese beetle (*Popillia japonica*) and the Europead willow leaf beetle (*Plagiodera versicolora*)—have defoliated an estimated one ann three quarter million trees. The larch case bearer (*Coleophora laricella*), seriously injured a quarter of a million larches growing as ornamentals; while the native fall webworm (*Hyphantria textor*) and the bagworm (*Thyridopteryx ephemeraeformis*) have seriously damaged an estimated quarter of a million trees each. In addition, the native walnut caterpillar (*Datana integerrima*) has been very injurious. The total seriously affected is estimated at two and a half million trees, many being well grown, handsome additions to lawns, streets or parkways. Not a few are highly prized for sentimental reasons. These trees may easily be worth an average of $100 each, the total value therefore being $250,000,000. Repeated annual defoliations mean serious lowering of vitality, and if continued for several years a condition obtaining in many sections, the beauty and utility of the trees are destroyed. The probabilities indicate more sweeping damage in 1932. Sickly, dying trees may be a liability rather than an asset. The time is approaching and has come in certain localities, when it will be necessary to provide systematic protection for shade trees, if we would avoid extensive and irreparable losses.

The weakening of trees by several abnormally dry seasons and the general loss of foliage described above has produced ideal conditions for serious damage by borers, especially the hickory bark beetle (*Scolytus quadrispinosus*), the two-lined chestnut borer (*Agrilus bilineatus*) and the bronze birch borer (*Agrilus anxius*). This has already commenced and more severe damage may be expected in the next season or two. It is by all means advisable to make comprehensive plans for spraying in areas where these various insects were numerous last year. This alone is not sufficient, since the weakened trees need feeding. Otherwise they may succumb to attack by various borers.

The developments in 1931 in relation to insect pests of shade trees have been of exceptional interest. Three introduced insects—the elm leaf beetle (*Galerucella xanthomelaena*), the Japanese beetle (*Popillia japonica*), and the European willow leaf beetle (*Plagiodera versicolora*)—

caused very severe and general damage in the northeastern United States. A fourth species, the larch case bearer (*Coleophora laricella*), was also extraordinarily abundant. The general depredations by these four introduced species were followed by widespread and serious damage by several native pests, especially the fall webworm (*Hyphantria textor*), the bagworm (*Thyridopteryx ephemeraeformis*) and the walnut caterpillar (*Datana integerrima*).

The general defoliation early in the season, mentioned above, suggested the possibility of giving a more definite picture than one characterized by some indefinite statements, such as general or sweeping damage in specified areas. It is possible to approximate the number of street and other shade trees in various localities, and with this as a basis, we estimated the number of trees which had been seriously affected by these different insects.

In the urban areas of Connecticut, that is cities and villages having a population of 3,000 or more, there are nearly half a million street trees. This figure is based on an average of 2.666 miles of streets per 1,000 inhabitants, in 160 cities with a population of less than 500,000 each, and the average number of trees per street mile in 16 cities having a population of 1,500,000 to 25,000, as indicated by statistics gathered by one of the large insurance companies and filed in the New York City Library. It is evident, so far as the State of Connecticut is concerned, that approximately half of these trees escaped serious insect injury. This is particularly true of cities and villages in the northern portion of the State and also of a number of others where there had been more or less systematic protection of the street trees by spraying. Approximately two-thirds or three-fourths of the trees in many New England communities are elms and if, to be on the safe side, we consider that there are only half, then the number of elms in this area would be nearly 125,000, and were we to reduce this by one-fifth in order to be a little more conservative, we would have approximately 100,000 elms in these urban communities, a considerable proportion of which were seriously damaged or entirely defoliated by the elm leaf beetle last summer. These figures may seem a little high, and for good measure we would throw in an estimated one-third million of trees (25 per mile, mileage based on U. S. Bureau Public Roads figures) on the rural roads of the State. Reducing this by one-half to agree with the estimate in relation to the trees in urban areas, we have nearly 170,000 additional trees which had not been counted previously, and many of which were known, from personal observation, to have suffered very severely by elm leaf beetle injury. It would even be possible to estimate that but one-

fifth of this 170,000 had been seriously damaged by the elm leaf beetle, and we would have a leeway of 50,000 trees to offset any possible overestimate of the number of injured elms in the urban sections.

Insect injury, presumably severe damage, by the elm leaf beetle has been recorded for the past season by the Insect Pest Survey of the United States Department of Agriculture, from the New England States and also from New York, Delaware, Maryland, Virginia, Ohio and Kentucky, and from the far west, Oregon and California. It is evident that the outbreak was not restricted in its nature. The probabilities are that southern Connecticut suffered relatively more than the other New England States, and in order to be well on the safe side, we estimated that the number of elms thus affected in all other sections of New England was approximately the same as in Connecticut, namely 100,000, despite the fact that the aggregate population and area is much greater than in Connecticut.

In New York State, with its much larger population than Connecticut, we placed the number of beetle defoliated elms at 250,000, and then for the other States mentioned, namely, Delaware, Maryland, Virginia, Ohio and Kentucky, and we would also include, from personal knowledge, portions of New Jersey and eastern Pennsylvania, at least, we added another 200,000 trees, making a total of 650,000 elms on the streets and roads in the northeastern United States which were seriously damaged by the elm leaf beetle during the summer of 1931. The estimates took no account of the trees on private property. These latter would easily equal in number those upon the streets and highways, and the presumption is that approximately an equal number were severely damaged. Summarizing, the grand total of elms seriously injured by the elm leaf beetle this last season was over a million and a quarter, namely 1,300,000 trees.

A provisional forecast of more serious injury was made last year. The depredations of 1931 were more severe than those of 1930. The beetles developed in enormous numbers last summer, favored probably by the abnormally warm and at least relatively dry conditions. Present indications lead us to expect more severe damage in 1932. The probability of extremely large numbers of the insects in the infested areas is also suggested by the recent finding of many beetles in private homes. The widespread and serious injuries of 1931 occurred only in areas where there was no spraying. It is entirely possible to prevent such unfortunate conditions another season. This means a recognition of the potentialities of the beetle and making provision for spraying before there has been serious injury.

Those who had occasion to travel in the generally infested Japanese beetle area the past summer could hardly have failed to note the very general defoliation of shade trees in sections centering approximately on Philadelphia and extending south to Wilmington, Delaware, and north to Trenton, New Jersey, or thereabouts. It is not easy to suggest the number of trees which have been defoliated in this area during the summer by the Japanese beetle. It would seem entirely within probabilities that at least a quarter of a million of trees may have lost their foliage as a result of the activities of this destructive pest. It should be remembered, in this connection, that the Japanese beetle is a general feeder. It shows a marked preference for horsechestnut, linden, elm, willow, apple, peach, sweet cherry, plum, rose, grape, Boston ivy and Norway maple, to mention some of the trees and vines upon which the pest feeds most readily.

The Japanese beetle attacks a considerable variety of trees and shrubs. It is erratic in its habits. It is spreading rapidly in spite of governmental efforts to check dissemination. The serious damage to shade trees and ornamentals in the generally infested section is destined to be extended over the sparsely infested area, which now includes parts of Virginia, Maryland, Delaware, Pennsylvania, all of New Jersey, the southern part of New York, all of Connecticut and Rhode Island, and two good sized areas in Massachusetts. In the normal course of events, it follows that the quarter of a million shade trees defoliated by the Japanese beetle in 1931 is likely to be doubled, trebled, or even increased to a much greater extent as the insect becomes more abundant in the recently infested territory. A reasonable regard for shade trees compels the recognition of this fact and if shade trees are desirable, the early adoption of measures which will insure reasonably satisfactory control.

The third insect in this deadly trio is the European willow leaf beetle. It is now widely distributed in southern New England, New York and south to New Jersey, Pennsylvania and Maryland. Fortunately, in one respect, the willow does not occupy a very important place as a shade tree. It is somewhat generally grown, and in many sections of the infested area it has been severely damaged by this recently introduced pest. It seemed reasonable to approximate the number of beetle defoliated willows in the eastern United States at 200,000, though it must be admitted that this is a tentative estimate. This pest produces three generations annually, and when conditions are favorable, largely prevents the foliage from functioning. The inevitable result is that the trees are weakened. They are certainly far from beautiful when the

leaves are changed throughout most of the summer from a bright green to a hideous gray. The willow situation is even more serious due to the recently discovered willow scab fungus and the very general infection, serious injury and killing of many trees in New England.

It would seem as though this was enough, so far as shade trees are concerned. The beautiful larch suffered greatly the past summer from the depredations of the larch case bearer, the foliage being partly to mostly completely destroyed in southern New England north into the Berkshires of Massachusetts, New Hampshire and probably Vermont, and in corresponding areas in New York State, including extensive tracts in the Adirondacks. A large proportion of these larches were forest trees, and yet there must have been many thousands, probably 250,000, which could be classed as ornamental or shade trees. Here again, timely spraying would have prevented serious damage.

Fall webworm was exceptionally prevalent and injurious in the northeastern United States, including all of New England, New York, New Jersey, Pennsylvania and south, at least, to Delaware. This insect occurs upon a considerable variety of trees, a great majority of which could not be classed as shade trees. There were very likely a quarter of a million, possibly half a million, (we are using in our estimate the smaller number) of shade and ornamental trees which were seriously disfigured by this common pest.

The bagworm was abundant and injurious in portions of New York, Pennsylvania and Maryland, and with no exact basis for making an estimate, we assume that this insect may have seriously affected a quarter of a million shade and ornamental trees in the areas where it was numerous.

The walnut caterpillar was generally abundant and destructive in southern New England, Ohio, Indiana and Delaware. Walnuts are more generally recognized as nut trees, and yet not a few are important as shade trees. They are mentioned simply as another instance of presumably severe damage by leaf feeders the past season.

The grand total of shade trees and ornamentals in the northeastern United States severely damaged the past season by the elm leaf beetle, the Japanese beetle, the European willow leaf beetle, the larch case bearer, the fall webworm and the bagworm, all but two introduced insects, is two and a half million. These estimates do not take into account many other trees seriously damaged by less prevalent leaf feeders. Most of these trees are well grown, handsome additions to lawns, streets or parkways. Some stand upon lawns of magnificent estates. Not a few are highly prized for sentimental reasons. These

trees may easily be worth an average of $100 each, and their total value would therefore be $250,000,000. There is no gainsaying the fact that well grown trees are material assets to communities. They are essentials in parkways now being so generally developed in metropolitan areas. They are major landscape features in country sections. Repeated annual defoliations mean serious lowering of vitality, and if continued for several years, a condition obtaining in many sections, the beauty and utility of the trees are destroyed and many of them are bound to succumb to insufficient food, droughts and other conditions which ordinarily would not prove serious. Orchardists learned years ago, the necessity of keeping trees in good condition if profitable crops were to be grown. It is equally true of shade trees. The value of shade and ornamental trees is very largely proportional to their well being. A sickly, dying tree may be a liability rather than an asset. Many branches on trees are in a weakened, sickly condition as a result of several years defoliation. Some may even jeopardize public safety. There is a possibility of damage claims in the case of an accident. Can tree owners afford to take these risks? The time is approaching when it will be necessary to provide systematic protection for shade trees, if we would avoid extensive and irreparable losses. It has come in the case of some localities.

The foregoing is by no means a complete summary of insect development the past season in relation to shade and ornamental trees. There were severe droughts in 1929 and 1930 and in some localities a less than normal supply of moisture in 1931. These general causes have affected the vitality of many trees. The extensive defoliation discussed above has also been an important adverse influence. It was pointed out last year that outbreaks by borers were likely to follow the unusual climatic conditions of recent years. This general prediction has come true in relation to several of the more dangerous borers, and the probabilities are that the end in this development has by no means been reached.

The hickory bark beetle (*Scolytus quadrispinosus*), one of the most dangerous insect enemies of hickory, has killed trees here and there, and there is an excellent possibility of there being more general injury another season. The two-lined chestnut borer (*Agrilus bilineatus*), a deadly enemy of oaks with reduced vitality, has killed many beautiful trees. This has been particularly evident in localities where drought conditions were accentuated by ill advised draining, which later resulted in lowering the water table at a time when there should have been no interference with the normal supply of soil moisture. In one instance

coming to our attention, the trouble was further aggravated by the cleaning up of underbrush and the removal of much of the normal mulch, and as a consequence, two-lined chestnut borers, breeding in relatively small numbers in the woodland, were attracted to the sunlit trees of the margin and killed an extraordinarily high percentage. The flowering dogwood in one of the drought affected areas, showed a most interesting correlation between scorching of the bark as a result of a light woodland fire and a prompt and deadly invasion by the common flat-headed borer of the apple (*Chrysobothris femorata*). A striking instance of the effect of drought and lack of nutriment came to notice the past summer. Some 37 weeping white birch planted about thirty years ago and originally magnificent specimens, showed a very serious infestation by the bronze birch borer (*Agrilus anxius*). Half of these trees were three-quarters dead and the other half so badly infested that they would probably be in the same condition next year. The trees were growing in a light, sterile soil, a location where drought effects would be at a maximum. It is more than probable that serious infestation could have been prevented had there been earlier feeding to maintain a vigorous growth.

The desirability of stimulating growth by feeding has been referred to in connection with borer injury. The entomologist is ordinarily concerned with the direct control of insects, and in the case of the leaf feeders, his recommendation is usually spraying in order to destroy the pests before they have caused material injury. There is a question as to whether this goes far enough, particularly in the case of millions of trees, which have already been seriously damaged by leaf feeders and are in an ideal condition for invasion by borers. It is well known that the vigorous tree suffers less from insect attack than one with lowered vitality. It is our claim that these weakened trees should be fed. It is our belief that the entomologist is justified in going farther than recommending the usual control measures. He might advantageously give consideration to the physical condition of the tree and if it is below normal, recommend measures which will hasten the development of a vigorous growth.

Mr. O. I. SNAPP: What control measures are you using for those borers?

Mr. E. P. FELT: I mentioned two in particular. I am convinced that we can secure a considerable degree of protection by spraying about the first of June with arsenate of lead for the two-lined chestnut borer, because the adults do an appreciable amount of feeding on the foliage.

Furthermore, we have demonstrated that beetles compelled to feed on poisoned foliage succumb within 48 hours. In the case of the bronze birch borer, I believe that spraying with poison protects them to a considerable extent. Protection from both of these borers is possible to a considerable extent by feeding the trees. It stimulates the growth to such an extent as to heal early wounds made by the young borers. In the case of the hickory bark beetle, somewhat the same effect obtains, though we haven't demonstrated that quite so much protection is obtained from spraying. It is our opinion that invasion by both of these borers is permissible ordinarily only when the tree has a reduced vitality. This is very apt to follow periods of excessive drought.

PRESIDENT J. S. HOUSER: The next paper will be presented by M. D. Leonard.

THE PINK BOLLWORM IN PORTO RICO

By M. D. LEONARD, *Rio Piedras, P. R.*

(Withdrawn for publication in the Journal of the Porto Rico Department of Agriculture **16** (1) January 1932)

PRESIDENT J. S. HOUSER: The next paper will be read by E. M. Searles.

A PRELIMINARY REPORT ON THE RESISTANCE OF CERTAIN LEGUMES TO CERTAIN HOMOPTEROUS INSECTS

By ED. M. SEARLS, *Wisconsin Agricultural Experiment Station*

ABSTRACT

Experiments and field observations have indicated that in Wisconsin certain strains of canning peas and of alfalfa vary in their resistance to the pea aphid(*Illinoia pisi* Kalt.) and the alfalfa leafhopper (*Empoasca fabae* Fabr.) respectively in direct proportion to the value of the yellow color of the plant.

During the past season it was frequently observed that in some fields of canning peas there were color variations between the individual plants in the fields as well as between the different fields of peas and that this variation in color extended between yellow and green. It was further observed that the yellower peas were not as severely injured by aphid attack as the greener varieties or individuals. This condition was particularly obvious in a field containing many varieties of peas planted for the purpose of testing the purity and germination of seeds sold to Wisconsin canners by commercial seed producers. Quantitative tests

were made in several instances both within and between varieties and it was definitely indicated that the yellower peas were either avoided by the aphids or that the aphids found these particular plants unsatisfactory as sources of food. These tests further indicated that the degree of infestation of aphids was directly proportional to the value of the green color of the plants. In some varieties the colors varied from green to yellow within the varieties. Variations grading from green to yellow were also found between varieties. It was found that in the instance both of individuals and varieties, the plants having the yellower color were the freest from aphids.

In some instances, particularly in those of some of the individual variations within varieties, sufficient numbers were not available to draw definite conclusions. In several instances, however, sufficient numbers of plants were available. The results are given in the table.

At present it is not possible to designate a color by a name or by descriptive terms which will mean exactly the same to everyone. For that reason, the author had recourse to a volume on color in which colors of all possible combinations of value, purity, and hue are given in convenient gradations from one hue to the next throughout the spectrum. The "Dictionary of Color" by Maerz and Paul was used for this purpose. Comparisons between the freshly picked plants and the color chart were made under standard light conditions so as to avoid all possible confusion due to reflections or varying light intensity.

Relative Positions of Selections in Field. Numbers 2, 3, 4 and 5 were contiguous, while Nos. 1 and 6 were adjacent in a different part of the field which for some undetermined reason bore a much heavier infestation than the rest of the field. "Spotty" infestations of this nature are quite common in fields of canning peas. For exact comparisons, Nos. 1 and 6, should be considered separately from Nos. 2, 3, 4 and 5. These data were taken at the time at which the infestation of aphids was at its peak or slightly past the peak. In each case the infestation was ascertained by removing and counting the number of aphids accumulated about the growing tips of ten plants. In the case of selections 1 and 6, No. 1 bore a normal crop of peas while No. 6 was killed by the aphids without producing seed. Nos. 5 and 6 are identical inasmuch as they are different samples of the same variety planted in different parts of the field.

Selections Arranged According to Value of Hue. It may be stated in general terms and without danger of resultant confusion which so frequently occurs where colors are mentioned, that selection No. 1 contained the yellowest plants. Selection No. 5 contained the greenest

plants. Selections Nos. 2, 3 and 4 were intermediate in color between selections 1 and 5 and became increasingly greener in the order named. For the purpose of this report only inherent colors are considered.

SELECTIONS ARRANGED ACCORDING TO VALUE OF HUE, FROM YELLOW TO GREEN, AND SHOWING RELATIVE INFESTATIONS, MADISON, WIS. 1931

Selection	Color (Maerz & Paul)	Infestations July 1	July 3	July 5	July 6
1	22J5	620	496	404	720
2	22J6	86	94	27	85
3	22L6	105	80	27	91
4	23H6	118	211	93	136
5	23J7	512	252	308	217
6	23J7	2200	1064	203	465

SELECTIONS PLANTED FOR FURTHER OBSERVATION. Seeds from selections Nos. 1, 2, 3, 4 and 5 were planted on July 14, and the resultant plants artificially infested with aphids. Sufficient seeds were available to plant at least three contiguous rows ten feet long of each variety. Selection No. 5 represented the hue of greatest green value. It was therefore used as the check for susceptibility and two series of three rows each were planted between selections 1 and 2, and between selections 3 and 4. Irrigation was resorted to in order to prevent drought injury to the plants.

RESULTS OF SECOND PLANTING. Under the hot, dry conditions which obtained during the ensuing season, and in the absence of all inimical agencies, the aphids multiplied with tremendous acceleration with the result that the selection used from Nos. 5 and 6 was killed by the aphids. Nos. 1 and 2 were infested with aphids but bore a normal crop of peas. The infestation on numbers 3 and 4 was heavier than on Nos. 1 and 2 but the plants survived and produced seeds although the late season buds and pods were ruined by the aphids. Relatively small quantities of seed were available for planting on July 14 and because of the small number of plants quantitative data on infestations were not taken. Resistance was judged only by the inherent ability of the selections to produce peas under the severe conditions of infestation imposed.

BIOLOGICAL AND CHEMICAL NATURE OF RESISTANCE. Hybridizations were made among the various selections, both resistant and susceptible, for the purpose of investigating the genetic nature of the resistant factor or factors. The nature of this resistance is also being studied from the chemical point of view.

ALFALFA AND SWEET CLOVER RESISTANCE TO LEAFHOPPERS. Variations in hue were also noted in selections of Grimm alfalfa. A pre-

liminary test clearly indicated that the selections which varied toward yellow also showed less injury from leafhoppers than those of greener hue as indicated by the incidence of alfalfa yellows. It was also observed that an analogous condition existed in the instance of sweet clover although no experiment was instituted to demonstrate either the nature or extent of the resistance.

CONCLUSION. Although this report covers only a preliminary investigation into this very interesting and promising field of entomological research and is based upon data collected and observations made during the unusual growing season of 1931, certain conclusions seem justified. Discussion as to the nature of the factor of resistance would be idle at this time, since no work has been completed which would demonstrate the nature of that factor. The fact of resistance remains however and certain definite relations appear to be constant in all instances where resistance was observed; in each instance an insect with haustellate mouthparts was involved, the phloem is generally believed to be the source of food for the insects involved, the host plants were all closely related within the legume family.

PRESIDENT J. S. HOUSER: We will now listen to a paper by Dwight Buchanan.

A BACTERIAL DISEASE OF BEANS TRANSMITTED BY *HELIOTHRIPS FEMORALIS* REUT.[1]

By DWIGHT BUCHANAN, *University of Minnesota, St. Paul, Minnesota*

ABSTRACT

Controlled experiments in the greenhouse show that *Heliothrips femoralis* Reut. may transmit a bacterial disease of beans. While thrips are known to disseminate several virus diseases, this seems to be the first case where they have been proved experimentally to disseminate a bacterial disease of plants. Dissemination of this bacterial pathogen by thrips seems to be a mechanical process.

It has been well established by several workers, that insects are able to transmit several fungous, bacterial and virus diseases of plants. Until quite recently, however, very few economic entomologists have turned their attention to the relation of insects and plant diseases. Research

[1]Paper No. 1077 of the Journal Series of the Minnesota Agricultural Experiment Station. Cooperative investigations between the Division of Entomology and Economic Zoology, and the Division of Plant Pathology and Botany.

in this neglected field is uncovering facts that are of interest to workers in both economic entomology and plant pathology.

Recently attention has been called to the importance of thrips as vectors of plant diseases. Pittman (7), in 1927, demonstrated that *Thrips tabaci* Lind. was a vector of spotted wilt, a virus disease of tomatoes in Australia. This was later confirmed and emphasized by Samuel et al. (8), who demonstrated *Frankliniella insularis* Frankl. to be a vector of the disease. Hansen (2), working in California has reported that *Thrips tabaci* Lind. and *Frankliniella* sp. may disseminate fig-decaying organisms. Jarrett (4), working in England with *Thrips tabaci* Lind. found that it transmitted several virus diseases of tomatoes. Kenneth M. Smith (9), found that *Thrips tabaci* Lind. transmitted ringspot, a virus disease of tobacco. Linford (5 and 6), has proven recently that streak, a virus disease of peas, and the pineapple yellow-spot are disseminated by *Thrips tabaci* Lind.

Burkholder (1), Zaumeyer (10), Hedges (3), and others have described in detail several bacterial diseases of beans caused by *Phytomonas phaseoli, Phytomonas phaseoli* variety *fuscans, Phytomonas medicaginis* variety *phaseolicola,* etc. They, however, did not include in their experiments any controlled work with insect dissemination. Recently, the writer has obtained evidence to show that a bacterial disease of beans may be disseminated by *Heliothrips femoralis.* Reut.[2]

The writer's attention was called to the possibility of thrips transmitting a bacterial disease of beans when the control plants, in an experiment on artificial inoculation of beans with bacteria, showed typical symptoms in spite of the fact that these control bean plants were placed some distance from the inoculated ones. Upon examination of these plants it was found that they were infested with thrips, and that the bacterial lesions were associated with their feeding wounds. It was decided to test the thrips experimentally as to their ability to transmit the disease.

Seed of a brown and a white variety of kidney beans were planted in four inch pots and kept in the greenhouse at a temperature about 80° F. More than a hundred plants were divided into four groups, which were kept in insect proof cages especially made for this experiment. One group was kept free from thrips, and the plants were not inoculated with bacteria. The second group of plants was infested with disease-

[2]The identification of the species was kindly made by Dr. H. Morrison of the U. S. National Museum, Washington, D. C.

free thrips for reproduction. The third group of plants was artificially inoculated with a bacterial culture, using two methods:

a. A bacterial suspension in water was sprayed on the plants with an atomizer. In some cases the leaves were pricked with a needle after spraying, while in others they were not.

b. Bacteria from an agar culture were taken up on a platinum needle and pricked into the leaves, stems and petioles of the plants.

The fourth group of plants was infested with thrips that had previously fed on diseased plants, and were supposedly contaminated with the pathogen.

The above experiments were repeated several times with the following results:

1. Plants free from bacteria and thrips remained vigorous and healthy. No typical symptoms of the disease developed.

2. Plants infested with disease-free thrips grew well, but had the typical chafed leaf surface, which thrips usually produce upon feeding.

3. The plants artificially inoculated with the bacterial culture, in due time, developed the typical symptoms characteristic of this bacterial disease.

4. The plants infested with thrips, which had previously fed on diseased plants, developed symptoms similar in all respects to those found on the artificially inoculated plants. In all cases they were closely associated with the feeding wounds made by the thrips. There was no appreciable difference in incubation period following either the bacterial suspension or thrip inoculation.

The bacteria were isolated from the lesions developed in the wounds made by thrips, as well as from those lesions produced following artificial inoculation. Small strips were placed in a solution of mercury bichloride in order to sterilize the outer surface. From here they were put into a tube of sterile distilled water to rinse off the mercury bichloride, and then put in a second tube where the leaf tissue was thoroughly crushed with a sterile rod. Several platinum-needle loops of the solution were transferred to tubes of melted potato dextrose agar and plated in Petri dishes. When the cultures developed, representative colonies were transferred to agar slants. These cultures were used in further inoculation experiments.

The gross cultural characteristics of the bacteria isolated from lesions produced after the feeding by thrips and also by artificial inoculations were identical. The specific identity of the bacterial pathogen has not yet been finally determined.

Experiments were made in which individual thrips were confined in small cages to a desired portion of a leaf. These cages are made from light glass cylinders about ¼ inch in diameter with a metal lid on one end, and a silk bolting cloth on the other. The metal lid was clamped over the lower surface of the leaf, placing the cage with the bolting cloth cover over the upper surface of the leaf, on which surface a desired number of thrips were confined for feeding.

The individual thrips in these cages were allowed to feed for a definite time on diseased plants and then they were transferred to healthy plants for varying periods of feeding. In these experiments typical symptoms of the disease were produced following feeding by the contaminated thrips. Successful transmission was obtained in preliminary investigations by using thrips that had fed on diseased plants for a period as short as 40 minutes; further study is needed, however, to verify this point. This, together with the fact that the incubation period following insect inoculation is not appreciably lengthened, as compared with artificial inoculation, would indicate that the transmission is mechanical. Further experiments are in progress to determine the exact manner of transmission, and the minimum time necessary for thrips to feed on diseased and healthy plants in order to be able to transmit the disease.

High temperature and humidity greatly enhance the rate of action of the pathogen on the plants. It also causes the thrips to be more active, and the damage is correspondingly greater under such conditions.

The writer is indebted to Dr. A. A. Granovsky of the Department of Entomology under whose supervision the work was carried out, for many favors and helpful suggestions, and also to Dr. J. G. Leach of the Plant Pathology Department, for kind assistance in this problem.

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Mr. RAY HUTSON: I would like to ask whether you have noticed or have any idea as to why the different varieties were affected differently.

Mr. DWIGHT BUCHANAN: No. It seems to be some condition inherent in the plant. There is apparently some difference among various plants in their ability to resist various types of diseases. It is possible that this result may be of a similar nature.

PRESIDENT J. S. HOUSER: We will now listen to a paper by Charles E. Smith and Norman Allen.

THE MIGRATORY HABIT OF THE SPOTTED CUCUMBER BEETLE

By CHAS. E. SMITH and NORMAN ALLEN, *Bureau of Entomology, United States Department of Agriculture, in cooperation with the Agricultural Experiment Station of the Louisiana State University*

ABSTRACT

A brief report is made on the observations and experiments conducted in Louisiana and northward through the Mississippi Valley relating to the seasonal habits of the spotted cucumber beetle, *Diabrotica duodecimpunctata* Fabr. According to the information obtained, this species regularly migrates northward during the spring and early summer and the offspring migrate back to the South during the fall, with none surviving the winter north of central Missouri, and no true hibernation occurring in the South. The number of generations matured during this annual advance and retreat is not known.

According to recent observations and experimental data obtained on the habits of the spotted cucumber beetle, *Diabrotica duodecimpunctata* Fab., it seems evident that this species regularly migrates northward during the spring and summer and back southward during the fall and early winter. Those migrating northward consist largely or entirely of recently issued beetles, partly from the spring brood produced in the South and partly from progeny of early migrants from the more southerly areas which stop in intermediate areas. Besides these, a few of the

beetles which have overwintered in the South may drift back northward for a hundred miles or so during early spring. The beetles migrating to the South are composed largely of the brood that emerges during the fall in the northern states. These to a large extent constitute the winter population in the southern states.

Coincident with increased production of winter and spring truck crops in the South during and following the World War, came a marked rise in reports of the spotted cucumber beetle as a pest of economic importance. Consequently, during the winter of 1924–25 the species was made a major project at the Baton Rouge station. Occasional notes, however, had been made on its occurrence and ravages prior to that time.

From 1923 to 1925 we first recognized the rather sudden disappearance of the spring brood of beetles from Louisiana fields, the scarcity of active forms during the summer and early fall, and the reappearance of the species in normal numbers in the late fall and early winter. In order to ascertain the cause of this condition, efforts were first made to determine if aestivation occurred during this period. From 1924 to 1929 attempts were made to carry the species through the summer in cages. With the view of obtaining optimum conditions for aestivation, granting its possibility, the cages were located in various situations and variously provisioned. Intensive searches were also made for aestivating forms in Louisiana. The results obtained from all of these studies were negative. It was not found possible to carry the insect through the summer in Louisiana nor to find forms occurring naturally in a quiescent state. Although a few beetles are present in parts of the South throughout the year, being more plentiful some years than others, the insect breeds scantily during the summer and the local population is at a very low ebb by fall.

In 1927, after three years of negative results from the aestivation studies, Mr. J. E. Graf suggested that the species might migrate northward during the spring and back to the South in the fall. Although evidence supporting this theory had already been obtained in Louisiana, a study of the field population of the species in the Mississippi Valley and adjacent territory was started in June, 1929. In this study, observations were made on the extent of the area occupied by active beetles during the winter, the populating of the fields north of this area during the spring and summer and the populating of the Southern territory from the North southward during the fall. During the spring of 1931 information on the populating of the fields by partially mature adults and on the time of the emergence of the spring brood in different sections

from the South to the North was obtained. Also during the fall of 1930 and spring of 1931, through the courtesy of the officials and employees of the U. S. Bureau of Entomology Cotton Insect Laboratory at Tallulah, Louisiana, the records of seven beetles collected by airplane were obtained.

The data obtained in these studies indicate that in the Mississippi Valley this beetle does not survive the winter north of central Missouri, and also that in the South no true hibernation of long and continuous duration occurs. Though the first beetles appearing in the fields north of its active winter range are mature, or practically so, they are fresh in appearance and very probably are individuals which issued early in the more southerly areas and migrated north. These are followed within about two weeks by partially mature, but not freshly issued, beetles. The influx of these partially mature beetles in the North occurs simultaneously with the issuing of the spring brood in the South and is preceded by favorable weather conditions. During the spring of 1931, from Baton Rouge northward in the winter range of the species, partially mature beetles appeared in the fields from two weeks to a month in advance of the issuing of the spring brood in the respective localities.

While the migration of this beetle seems to be an established habit, certain climatic factors aid, or are taken advantage of, in its accomplishment. Of these, surface winds, upper air currents, and temperature are probably the most important. A number of migratory flights have been observed during spring and fall, all of which occurred during periods of favorable winds, that is, with southerly winds during the spring and northerly winds during the fall. A temperature of 60° to 65° F., or above, is also necessary.

The migratory flights are specific and differ in several respects from ordinary flights about the field. The beetles cease feeding several hours in advance and usually obtain a vantage position by crawling to the tops of the host plants, or assemble on taller objects present in the vicinity, such as shrubs and small trees. When the proper time arrives, the migration starts with each beetle apparently flying independently, but with all going in the same general direction and at a speed considerably faster than is maintained during local flights. When normally high temperatures prevail and other air conditions are favorable, the migration flights are started in the late afternoon and probably reach a maximum at about dusk or early evening. During periods of lower temperatures, as may prevail in early spring and late fall, the flights may occur at any time during the day when conditions are favorable.

A distance of five hundred miles or more may be traveled during a

period of three or four days of favorable weather. This was determined during the spring of 1931 by closely checking the northern limit of the issuing of young beetles in the South with the simultaneous appearance of partially mature beetles in the North. These young forms were present throughout Missouri and the southern half of Iowa before beetles issuing in the South reached the Louisiana-Arkansas state line.

Altitudes ranging up to 1,000 feet, and possibly more, are attained during migration flights. Of the seven beetles collected by airplane at Tallulah, of which we were furnished the records, 2 were taken at 200 feet, 1 at 500 feet and 4 at 1,000 feet. Three of these beetles were collected during the fall of 1930 and four during the spring of 1931. In each case, northerly winds prevailed in the fall and southerly winds in the spring.

The first flight of the migration journey may be undertaken, favorable conditions prevailing, in about 48 hours after the beetles have emerged from the soil. However, they usually become mature and mate before the migration is completed. The number of flights required is indefinite, depending on weather conditions and the season. The period of migration is more prolonged in the fall. In the Mississippi Valley in the spring, a large percentage of the beetles feed on alfalfa after emerging and between flight periods. In the fall a somewhat similar habit prevails, but during the journey southward fall-flowering weeds, especially the goldenrods and several composites (Helianthus and Aster), are preferred hosts. In the North, Hubbard squash is a favored host of the males in the fall.

Mr. W. E. HINDS: It seems to me they have established pretty good evidence in support of the migration idea, and undoubtedly it may apply to many other insects besides the spotted cucumber beetle.

Mr. W. P. FLINT: I would like to ask if you have any data from other sections of the country to indicate migration further north.

Mr. CHARLES E. SMITH: There is a note by Mr. Stanley in the last issue of the Journal covering observations this fall. He reported seeing them moving southward at altitudes of 4000 to 6000 feet. I have had some correspondence with a man in southern Texas who was unable to secure specimens from the field during the summer. Other data have been secured from a number of men in different sections of the country which add weight to the theory of migration.

Mr. C. R. CUTRIGHT: Do you have any data on the length of the individual beetle's flight?

Mr. CHARLES E. SMITH: They cover about 500 miles or more during a period of two to four days of favorable weather. While they were still issuing in northern Louisiana we found partially mature beetles in Iowa. The migrations occur when we have favorable weather with the wind going in the right direction.

PRESIDENT J. S. HOUSER: We will now listen to a paper by W. E. Hinds and B. A. Osterberger.

RESULTS OF *TRICHOGRAMMA* COLONIZATION ON SUGAR-CANE BORER DAMAGE IN LOUISIANA IN 1931

By W. E. HINDS and B. A. OSTERBERGER, *Louisiana Experiment Station*

ABSTRACT

This paper presents a brief summary review of the work of 1931, as measured by three indices, which are considered significant, measurable and reliable. They include the destruction of borer eggs by parasitism, the moth population developed in the fields during the season—excluding the hibernating generation—and the percentage of cane joints showing one or more borer burrows per joint as the cane is cut at harvest time. These indices all point conclusively to a reduction of from 30 to 50% of the potential and prospective borer damage as a result of the colonization of from 5,000 to 6,000 parasites per acre at a favorable time.

GENERAL CONDITIONS OF 1931 TESTS. This work is a continuation of the investigations started at the Louisiana Experiment Station in 1927 to determine whether the usefulness of the native parasite, *Trichogramma minutum* Riley, can be increased in the fields by methods of mass production of parasites in the laboratory and field colonization at favorable times. Previous reports of portions of this work have been made.[1]

In the work of 1931 it was necessary to locate most of the colonizations on the southern edge of the cane belt, between Houma and New Iberia, as the borer infestation in this area was decidedly heavier than in the vicinity of Baton Rouge where it was too light to support field colonies early in the season. An effort was made to determine whether colonization in heavily infested areas of corn early in the season might serve to develop there on the eggs of *Diatraea* and *Heliothis* a local supply of parasites which might spread later into the adjacent cane fields without making demand upon further breeding and distributing facilities.

[1]Hinds and Spencer, Jl. Econ. Ent., Vol. 21, p. 273, 1928.
Ibid. Vol. 22, p. 633, 1929.
Ibid. Vol. 23, p. 121, 1930, etc.

The records indicate a very substantial benefit from such colonizations in corn, both from the reduction of moths produced in the area of corn itself and which would otherwise spread into the cane fields and also from the prompt destruction of a higher percentage of borer eggs in the cane than would have occurred under entirely uncolonized conditions from natural parasitism. An effort was made also to determine more definitely the approximate number of parasites required per acre of colonized field to secure satisfactory results. The various fields involved were measured with approximate accuracy. An effort was made to assure the liberation of parasites at a time when *Diatraea* eggs were available in considerable numbers, especially at the beginning of the second and third generations. The liberation in actually colonized areas was at the rate of between 10,000 and 11,000. In many cases only a single liberation was made, while in some areas a second liberation was made. The benefits of colonization in many cases were shared by the adjacent fields as well as the actually colonized areas and if these areas be included, the rate of liberation was approximately 5,700 per acre for the two sets of areas really protected. The rise in egg parasitism in the "adjacent fields" lagged somewhat behind that in the colonized areas, but followed more closely than was anticipated. Thus in a total area of approximately 75 acres, a very fair degree of parasitism was secured through the liberation of about 420,000 *Trichogramma*. The original colonizations were made deliberately in the heaviest infested fields that could be found during the last of June, especially, when second generation borer eggs became common. In several cases the fields selected had a broken stand of P. O. J. 213 stubble cane which had been interplanted with corn. The major part of the *Diatraea* eggs occurred upon the corn at the middle of June, while later the egg laying was concentrated on the cane. Biological studies have shown that the borer development is more rapid in corn than in cane and that a larger proportion of the eggs laid on corn succeed in producing full development of larvae and moths than is true with the eggs laid upon cane. For these reasons, the destruction of borer eggs on corn is likely to be more efficient in reducing the moth population resulting than is true with colonization in cane, while the cane crop benefits later in the season from the smaller number of moths transferring to the cane after the corn matures during the latter part of July or the early part of August. We have found no practicable way of measuring this latter phase of the beneficial effect in the cane crop.

We have no indication that under any ordinary circumstances the destruction of borer eggs by parasitism modifies the effect of any other

important natural control factor in any degree. The borer is not affected by limitation of food supply until the cane crop is practically destroyed. There is no indication of cannibalism among young larvae, which frequently occur in considerable numbers in the same leaf roll. There is strong evidence supporting the conclusion that with the sugarcane borer the differences in egg parasitism, shown in Table 1, as existing in an average of many fields representing colonized, adjacent and check areas, are significant and reliable indexes to the degree of benefit resulting from parasite colonization work by subtracting the average per cent of natural parasitism for the season from the average total in colonized areas.

During the season of 1931 we have found, in some sections where no sugarcane was grown, that a very heavy borer infestation occurred in Johnson grass and that this plant apparently served as the principal medium for the successful hibernation of a large borer population. During the past spring in such a location a very heavy borer infestation occurred in corn, and later in sorghum and shallu, but at the same time large numbers of borers could be found in the Johnson grass which was being grown as a pasture crop and occurred also along ditch banks and fence rows.

In our 1931 records we have examined under the microscope for parasitism over 250,000 *Diatraea* eggs. Through this lot the average number of eggs per batch has been 18.4. In a large majority of cases where parasitized at all, all of the eggs in the batch are parasitized. Unparasitized borer eggs practically all hatch. Very few are destroyed by predators. The natural mortality among newly hatched larvae appears to range usually from 75 to 95%. This mortality is greater on cane than it is on corn, and apparently much greater in periods of exceedingly hot, dry weather and during prolonged rains, etc., than during cooler, dry periods.

Ability of Trichogramma to Spread in the Fields. In the fields of cane and corn we now have positive evidence of the ability of Trichogramma to spread for very considerable distances in fields within a single generation of the wasp. In 1929 it was reported to us by a reliable field observer, that it was possible to follow the distribution of wasps from the center of colonization to a distance of approximately 500 feet in a northeasterly direction within three weeks after the colony was started. Beyond this point parasitism practically disappeared and no natural parasitism had then developed in any part of this area. This movement was in the direction of the prevailing light air currents. In the fall of 1931 an unusual opportunity for observations on this point

was found in an area of some 10 acres where cane had been planted the very last of August and during the first week of September. This tract was surrounded by maturing cane from which moths had spread into the young cane and deposited quite a large number of eggs throughout the area. None of these eggs could have been deposited more than three weeks before the examinations were made. When examined, it was found that *Trichogramma* had also spread throughout this area and, on the average, slightly more than 50 per cent of the eggs were found parasitized during the first generation of *Trichogramma* in this field. This was shown to be the case by the fact that very few of the *Trichogramma* had emerged from parasitized egg batches. The distance, as measured to the nearest cane in any direction, was 366 feet, and this was to cane growing northeast of the center of the newly planted area. It is more probable that the parasites had travelled more than this distance, coming with the prevailing midday light air currents, from cane to the south and southwest of the center of the newly planted area. As in our general practice, collections of borer eggs were made from various parts of this field and in this particular instance the average of 50 per cent of borer eggs parasitized prevailed practically throughout the entire tract of young cane. Large numbers of the batches of borer eggs found were freshly deposited and might have been parasitized by the wasps later.

Favorable Conditions for Colonizations. In cane which is growing fairly rapidly, the leaf perforation signs caused by first instar larvae may be seen in the topmost expanding leaves and will begin to show within three days after the larvae enter the leaf rolls. Such signs are fairly conspicuous and may be watched for as an indication of the beginning of hatching of eggs in first and second generations especially. The abundance of such leaf perforations is also an indication as to the abundance of egg batches in that locality. However it seems safer and better in judging the proper time for *Trichogramma* colonization work to watch for the time of general pupation of the borers of the first and second generations by splitting open a number of stalks, preferably of corn, in an area of heavy infestation. Liberate *Trichogramma* within a week or ten days after the first empty pupal skins for the current generation are found. By that time the egg laying for the next generation will be fairly well under way but comparatively few eggs will have reached a stage where it will be impossible for the parasites to parasitize them.

Practicability of Colonization. The practicability of the mass production of Trichogramma upon the eggs of *Sitotroga cerealella* bred

in corn, wheat, rice or other grain, is quite well established, although there are many difficulties to be overcome in this procedure.

Our general conclusions as to the value of colonizing *Trichogramma* in cane and corn fields are based upon the consistency of favorable results which we have secured in an average of many fields representing colonized and uncolonized areas and during the period of the past five years. These results have been fairly substantiated by recent reports of similar work done in Barbados.[2]

TABLE 1. PROGRESS IN *Diatraea* EGG PARASITISM BY *Trichogramma*, OBSERVATIONS MADE IN SOUTH LOUISIANA

Date: 1931	Total No. Eggs	Total Parasitized	% Parasitized
28 Fields Colonized June 13 and later			
June 26–27	4,704	2,540	54.0%
July 11–18	8,764	6,074	71.6
July 28–Aug. 3rd	5,849	3,309	61.7
Aug. 12–16	9,624	5,572	57.9
Aug. 27–Sept. 1st	21,158	15,064	71.2
Sept. 14–21	30,122	23,766	78.9
Totals and average % parasitized for season	80,221	56,325	70.2
11 Areas Adjacent to Colonized Fields			
June 26–27	962	354	36.8%
July 11–18	2,050	613	35.6
July 28–Aug. 3rd	2,885	1,393	48.3
Aug. 12–16	3,694	2,545	68.9
Aug. 27–Sept. 1st	6,987	4,501	64.4
Sept. 14–21	24,527	18,057	77.7
Totals and average	41,105	27,463	66.8
25 Uncolonized Check Areas			
June 26–27	439	1	.2%
July 11–18	2,456	472	19.2
July 28–Aug. 3rd	3,166	214	6.8
Aug. 12–16	7,310	1,652	22.6
Aug. 27–Sept. 1st	7,024	464	6.6
Sept. 14–21	14,839	4,021	27.1
Totals and average	35,234	6,824	19.4
10 Most Heavily Infested Fields, Uncolonized*			
Sept. 23–26	41,343	—	69.5

*These records should be compared only with those for Sept. 14–21 in table above. They are not comparable with the "average for season."

[2]Tucker, R. W. E. Cane Moth Borer. An Account of *Diatraea saccharalis* and the technique of breeding *Trichogramma minutum* and the results of two years field liberations of this parasite in Barbados. Rept. Dept. Sci. & Agr., Barbados, 1930–31, pp. 80–94 (Sept. 1931).

Tucker, R. W. E. The Mass Breeding of *Trichogramma minutum* to control *Diatraea saccharalis* in Barbados during 1930. Tropical Agr., Vol. VIII, No. 11, pp. 283–288 (Nov. 1931).

TABLE 2. CANE STANDS AND BORER MOTH POPULATION PER ACRE (FROM ALL EXCEPT HIBERNATING GENERATION) SOUTH LOUISIANA, 1931

No. Fields	Type Re-colonization	Computed Aver. Stand per Acre No. Stalks	Moth Population Aver. No. Stalks per 1 Emerg. Hole	Moth Population Aver. No. Moths per Acre
9	Colonized 6/13–8/15	27,480	6.21	4,425
4	Adjacent	26,640	5.41	4,924
10	Uncolonized Med. Infested	29,760	3.96	7,515
7	Uncolonized Heavily infested	27,720	1.99	13,930

TABLE 3. *Diatraea* INFESTATION AS SHOWN BY PER CENT OF JOINTS SHOWING 1 OR MORE BORER BURROWS AT HARVEST TIME, SOUTH LOUISIANA, 1931. AVERAGE OF ALL VARIETIES

Type of Field	No. of Fields	% of Joints Bored
Colonized	9	37.2
Adjacent	4	32.2
	13	35.0
Uncolonized checks	10	50.8
Uncolonized heavily infested	7	57.3
	17	53.5

GENERAL CONCLUSIONS. From a study of the foregoing tables, as well as from other records which are not shown herewith, we conclude that the strategic times for starting colonies of parasites are found in corn on first and second generation eggs and in cane soon after the general egg-laying for the second or third generations begins. It is essential that a supply of fresh borer eggs be available for the wasps. The abundance of these eggs is indicated in our records by the number of batches which an observer may find in a given period of time and taking the average of these records, it appears that there is good prospect for a colony becoming established when five or more batches of fairly fresh borer eggs may be found per hour by an experienced observer. Under these conditions the release of from 5,000 to 6,000 *Trichogramma* per acre may reasonably be expected to establish a colony successfully and to propagate by later multiplication within the fields with sufficient rapidity to reduce borer damage to an important degree. A marked increase in the percentage of eggs parasitized may be expected to appear in the colonized area within two weeks after the parasites are released, and parasites may be expected to spread from the colonized cuts into adjacent cuts, especially in the direction of the prevailing light, midday air currents. Release of parasites in alternate cuts, checker-board fashion, appears at this time to be a practicable and fairly safe procedure. Colonization should be made especially upon the centers of borer concentration in the first and second generations in corn and

in the second to fourth generations in cane. If the first release results in a fairly thorough establishment of the colony, a second release is probably unnecessary, but if for any reason the first release is not successful, subsequent releases may be made as the condition of borer infestation and egg parasitism indicate to be advisable, and such work may continue through the summer until the eggs for the hibernating generation are laid. The colonization of *Trichogramma* should not be expected to even approximate the complete elimination of borers, since the parasites depend upon a certain degree of host density for their own maintenance, but an important measure of borer repression may reasonably be expected and extremely heavy infestations may be prevented.

The average percentage of egg parasitism found in colonized areas in 1931 was not as high as has occurred in several preceding years. Neither did the average percentage from natural parasitism, in a group of areas that could be found during the last week of September, reach the figures occurring in both colonized and adjacent areas on comparable dates in September. The higher percentage of egg destruction in colonized and adjacent fields resulted in so checking the borer development that the parasites were able to overcome the heavier initial borer infestation occurring in the colonized areas and to reduce the actual moth production and cane damage in these areas during three or more generations, to approximately 60% of that occurring in the more lightly infested, check areas. In the colonized fields which were the most heavily infested that could be located at the beginning of the season, the number of moths produced became by October only approximately one-third of that produced in a group of heavily infested, uncolonized areas. The percentage of joints showing one or more burrows was decreased by fully 35% in 1931. It appears that it is worth while to assist nature by deliberately starting centers of parasite development as early in the season as they can be maintained in any areas. It is also evident that the multiplication of the borer in areas where natural parasitism is late in developing is extremely rapid, and the resulting damage to the cane is correspondingly heavy.

Taking all of these records together, it appears that in 1931 the field colonization of an average of from 5,000 to 6,000 *Trichogramma* per acre was effective in preventing from one-third to one-half the actual borer damage which might have been expected in these areas had no colonization of parasites occurred. The benefit of colonization may extend to a considerable distance from the centers where the releases are made. The costs for such protection against borer multiplication and damage ranged between one and two dollars per acre in 1931, but

may be expected to be less than this if similar work should develop on a commercial scale in the future. The benefit secured may reasonably be expected, on the average, to amount to more than one-third of the potential borer damage so far as field loss is concerned, and in addition to this a corresponding saving in the mill loss, which is a very serious matter, in heavily bored cane.

It now appears that sugarcane growers may adopt the field colonization of *Trichogramma* as a method of borer control or repression with as good prospect of profit therefrom as they have with almost any other cultural or borer control practices which they may use.

Mr. C. H. ALDEN: What type of deposition cages are used for the grain moth?

Mr. W. E. HINDS: We use a 9-inch battery jar, putting in from 12,000 to 15,000 moths per jar. Previous tests indicate that we get a higher rate of egg deposition per female with such a jar than with a smaller one and the amount of labor is greatly reduced. We use wire screen to cover the jar which is standing upright.

PRESIDENT J. S. HOUSER: We will now listen to a paper by H. A. Jaynes.

COLLECTING PARASITES OF THE SUGARCANE BORER[1] IN SOUTH AMERICA

By H. A. JAYNES, *U. S. Bureau of Entomology, Trujillo, Peru*

ABSTRACT

In collecting and rearing parasites of the sugarcane borer (*Diatraea saccharalis* Fab.) in the Argentine and Peru, several species were found, but large shipments were made of two species only. Over 637,000 puparia of the dexiid fly, *Paratheresia claripalpis* V. d. W., and 63,000 females of the wasp, *Ipobracon rimac* Wolcott, were shipped during three seasons.

During the last three and a half years parasites of the sugarcane borer have been studied in the Argentine and Peru, South America, and shipments of certain species have been made to the United States.

Work was started in the Argentine in August, 1928, and continued there until May, 1930, when it was transferred to Peru.

In the Argentine the most common parasite was the dexiid fly, *Paratheresia claripalpis* V. d. W. There were several species of Ipobracon

[1] *Diatraea saccharalis* Fab.

that were parasitic upon the sugarcane borer, but only two of these species could be obtained in sufficient numbers, and even these were never very numerous. A braconid, *Bassus stigmaterus* Cress., was found in small numbers, also a vipionid, *Apanteles xanthopus* Ashm., and a tachinid fly, *Leskiomima* sp. Neither of the last two were obtainable in numbers large enough for shipment. *Telenomus alecto* Cwfd. was found in the Province of Salta, Argentina.

In Peru the fly *Paratheresia claripalpis* V. d. W. and the wasps *Ipobracon rimac* Wolcott and *Bassus stigmaterus* Cress. were found and shipments were made of all three.

The puparia of Paratheresia were collected the first season, in the Argentine and Peru, by cutting out "dead hearts" in the cane (young cane shoots killed by a borer larva, as the central part of the plant, or "heart," dies first) and examining them for puparia, also by splitting corn that was still green. In cutting the cane great care was necessary to see that other shoots of cane were not cut or injured while the "dead heart" was being removed, as it had to be cut very close to the ground in order not to cut or break the puparium inside. More puparia were found in the corn and were easier to obtain. In cases where the corn was being cut for fodder it was necessary only to get permission to split the stalks, but other fields had to be bought, as splitting the stalks would have destroyed the value of the crop. Boys were hired to collect puparia and were paid according to the number of puparia they obtained. During the second and third seasons in Peru, puparia were obtained in large numbers by showing the farmers, who had small corn patches, samples of the puparia and full-grown fly larvae, and arranging to buy similar specimens from them. With this method it was not necessary to buy any corn-fields or supervise the cutting of the corn, and it enabled one to buy throughout a larger territory. Only those collections were bought that were in good condition and that contained a fair proportion of newly formed puparia and fullgrown fly larvae. When there were no larvae in the lot, it was a sure indication that the puparia had been obtained in corn that had become mature and dry, and that only a very small percentage of the puparia would be found to contain live material.

During the first season in the Argentine, 7,146 Paratheresia puparia were shipped between January 24 and April 18, 1929. In June and July, 1929, 27,754 were shipped from Peru. None were sent from the Argentine during the 1929–30 season. However, in June and July of 1930, 158,146 were sent from Peru, and in 1931, 444,017 were sent between April and July; making a grand total of 637,063.

These puparia were all shipped in cold storage, being packed in damp sphagnum moss, 100 puparia to a tin box, and ten tins being packed in a wooden box. These tins and boxes were carefully constructed so as to prevent any possible escape of secondary parasites while in transit.

In 1929, parasitized egg clusters of the borer were collected in the Argentine. These were parasitized by both *Trichogramma minutum* Riley and *Telenomus alecto*. From the Telenomus that emerged a few parasitized eggs were obtained in the laboratory, and 36 of these were sent to New Orleans on March 17. On May 13, 108 field-collected egg clusters containing both species were shipped. Both of these shipments were by boat and the material was kept in the vegetable room in transit. No Telenomus emerged from this material, although Trichogramma did. On March 11 of the next year, 80 clusters containing 611 eggs that appeared to be parasitized by Telenomus were sent by plane to New Orleans from Buenos Aires, and a few Telenomus emerged from this shipment.

A few cocoons of *Bassus stigmaterus* Cress. were sent both from the Argentine and Peru. These were shipped in the same manner as the fly puparia, in damp moss in cold storage.

Ipobracons were shipped in both cocoon and adult stages from the Argentine and Peru. Inasmuch as more than one species was present in the Argentine, and great numbers of cocoons could not be obtained at any one time to obtain a reasonable number of the same species emerging at the receiving end, breeding experiments were carried on to try and rear large enough numbers of cocoons or adults for shipment. Field-collected females attacked the borers readily in cages and large numbers of males and females were thus obtained, but mating did not take place with these reared specimens and the next generation were all males.

During the first season only two shipments of adult Ipobracon were made, one from Tucuman, Argentina, on May 13, which contained 50 females and a few males collected in Guemes; and the other on July 9, from Cartavio, Peru, which contained 150 females with a few males. There were 421 cocoons sent from the Argentine between October 30 and May 13, 1929, and 316 cocoons from Peru on July 9, 1929.

Both the adults and the cocoons from the Argentine consisted of more than one species, while all those from Peru were *Ipobracon rimac*. The following year, between July 7 and September 9, a total of over 20,000 females were shipped from the region around Trujillo to New York by boat and then to New Orleans by train. In 1931, on April 23 and May 9, 4,069 and 1,794 females, respectively, were sent by boat to New York. All of these were sent in the vegetable room of the ship. Finally, in

1931, arrangements were made with the Panagra Airways Corporation in Peru to accept the crates of wasps for shipment to Miami, Florida, where they were received and transhipped by train to New Orleans. The first shipment of adults by plane was made on May 8 and went through with 30.4 per cent alive. From this date to September 4 a total of 38,063 female Ipobracon were shipped by plane. The adults were shipped, in the first two years, in tin cans 5½ inches in diameter and 9½ inches high. The top had several small holes punched in it to allow a circulation of air and also contained one large hole which was stopped with a cork and was used for placing the wasps in the can. There were also a number of small holes punched in the bottom to allow for air and to drain off any water that might collect in the can. To the inside of each can was wired a 5-ounce bottle containing pure water. A piece of gauze was used as a wick inserted in the bottle, and a plug of cotton was held in place around this wick and over the mouth of the bottle by another piece of gauze. A small tin cup, about one inch long and half an inch wide and deep, was soldered to the inside of each can. Granulated sugar was placed in this for food. A small quantity of excelsior was placed in each can to allow the wasps to crawl about.

In trying to improve upon the container used, the number of wasps surviving decreased. Later, however, by using a crate without any cans and improving the water container, the percentage received alive increased considerably. In one crate containing 1,000 wasps, 915, or 91.5 per cent, were received alive in New Orleans, seven days after having been collected in Peru. From 22,168 females sent in cans only 1,409, or 6.3 per cent, were received alive, while from 15,895 sent in crates 12,049, or 75.8 per cent, were received alive. This crate was made of thin wood 12 inches long by 6 inches wide by 9 inches high, with solid ends, bottom, and top, while the two sides were covered with wire screening and black cloth, and with three or four strips of wood to protect the sides from being pushed in. The wasps were placed in the crate through a 1-inch hole made in the top. To each end was nailed a small tin cup containing granulated sugar and a drinking fountain containing a sponge and water.

The drinking fountain consisted of a tin can 4 inches high by 1½ inches wide by 1 inch deep, tightly sealed, except for an opening on one side at the bottom 1½ inches wide and three-fourths inch high. At this point was soldered a cup-like arrangement 1½ inches by 1 inch by 1 inch, making an L-shaped container. In this lower portion a sponge was placed which was kept moist by the large supply of water in the upright portion of the fountain. It was necessary that the tin be made air-

tight, except for this opening at the bottom, so that the water would not run out. The fountain was filled, and after the sponge was inserted it was inverted and nailed to the end of the crate. In this way a constant supply of water kept the sponge wet, whereas when a piece of sponge is resting in a can or jar the top becomes dry when the water level drops.

Although several different species of parasites were found, only two were obtained in large numbers and successfully shipped to Louisiana. However, it is hoped that in the future it may be possible to obtain some of the less numerous species and to ship them successfully.

PRESIDENT J. S. HOUSER: The next paper is by T. E. Holloway, W. E. Haley and E. K. Bynum.

RECEIVING PARASITES OF THE SUGARCANE BORER IN LOUISIANA

By T. E. HOLLOWAY, W. E. HALEY, and E. K. BYNUM, *U. S. Bureau of Entomology, New Orleans, La.*

ABSTRACT

Shipping and insectary methods used in handling South American parasites are described.

Parasite introduction to control the sugarcane borer (*Diatraea saccharalis* Fab.) in Louisiana was attempted as early as 1915, and considerable work was done in 1918, 1919, and 1920 (1, p. 63–66). However, it was only in 1928 that continuous work was begun under a special appropriation. In the summer of that year H. A. Jaynes went to Argentina, and later on he transferred his headquarters to Trujillo, Peru.

The seasons of the calendar year in Argentina are exactly the reverse of those in Louisiana, the Argentine hot season occurring coincidently with the winter time in Louisiana. Parasites were therefore available in Argentina when they could hardly be used in Louisiana. They could be sent to New Orleans without difficulty during the Louisiana winter, but no sugarcane or corn was then growing, and the borers were in hibernation. Breeding work in an incubator was attempted, but this was unsuccessful. It is possible that, at great expense, work might have been carried on in a greenhouse, but sufficient funds were not available.

Mr. Jaynes found that the most efficient parasite in Argentina, *Paratheresia claripalpis* V.d.W., a dexiid fly, was available in much larger numbers and at the right time in Peru, while Peru also had in consider-

able abundance one or more species of wasps of the genus Ipobracon, and, in smaller numbers, another wasp, *Bassus stigmaterus* Cress. As reported in another paper, he was successful in sending these insects to Louisiana. Bassus was received in such small numbers that neither breeding work nor field releases could be attempted, but many adults of *Paratheresia claripalpis* and *Ipobracon rimac* Wolcott were released from the shipments from Peru.

Until 1931, the flies and the wasps were both shipped to New York in cold storage, the flies as puparia and the wasps as adults. Here they were received by H. C. Hallock of the Bureau of Entomology, and W. H. Freeman, of the Plant Quarantine and Control Administration. These gentlemen then kindly reshipped the insects to New Orleans, after transferring them from the cold storage room of the ship to special refrigerator cases. On arriving at New Orleans these cases, which had been iced in New York, were allowed to warm up to outside temperatures, so that the parasites would not suddenly be brought from winter to summer conditions.

The first shipments of wasps were released directly in the sugarcane fields, but in the later arrivals they were fed for a day or so before release.

The puparia of the flies were placed in emergence cages measuring 20 inches by 15 inches by 15 inches and having a sleeve opening in front, a pane of glass at each end, and a white cloth covering the back. Ten thousand puparia could be placed in the metal drawer at the bottom of such a cage. The puparia were at first carefully separated from the sphagnum moss in which they were packed and placed on damp sand, but afterwards it was found about as satisfactory not to use sand but to place the puparia and sphagnum moss in the cage just as they arrived. The sphagnum moss was kept damp, water was sprayed on the cloth side of the cage, and water and sugar were given to the flies. The flies would emerge gradually, and as numbers became available they were collected by means of a suction collecting device and transferred to cloth and wire cages 36 inches by 13 inches by 16 inches, according to the specifications of the Gipsy Moth Laboratory for tachinid breeding (2, p. 18–20). However, the cages used each had a sleeve opening and also a top or end which was attached with wing bolts and could be removed. In this cage the flies were taken to the fields, where the top was removed and they were released. A later development was the placing of such a cage in a large bag made of black cloth for the trip to the fields, as darkening the cage reduced the activity of the flies. This cage was also used suc-

cessfully for the breeding of both the fly and the wasp. Breeding on a large scale was not seriously attempted, however, owing to the great numbers of wasps and flies which were being received and also to the fact that neither equipment nor personnel was available for extensive breeding work.

In 1931, Mr. Jaynes began shipping the wasps by airplane to Miami, Fla., where they were received by J. V. Gist of the Plant Quarantine and Control Administration and forwarded to New Orleans by express. In these shipments refrigeration was not used. The insects arrived at New Orleans on the sixth day after leaving Peru—a great saving in time over the consignments sent by ship, which arrived on about the 23d day.

Since the beginning of this work 16,161 wasps and 107,424 flies have been released on 14 plantations in Louisiana. On the whole, an emergence of 21.5 per cent of the flies was obtained, while the survival of the wasps was 24.6 per cent. As Mr. Jaynes points out, the shipping cage for the wasps was recently so improved that a survival of over 90 per cent has been obtained.

Possibly a word should be said about the parasite insectary. The boxes from Peru were opened in a cloth cage built inside an ordinary room and equipped with a vestibule and traps to prevent the escape of secondary parasites. The emergence cages were filled in this room, and then they were shoved through an opening in the wall to an outdoor room which consisted of a cloth cage in a screen cage. The cloth cage also had a vestibule. This outdoor room was equipped with electric fans, one of which was turned on automatically by a thermostat, and its humidity was controlled by a sort of sprinkler system, water being sprayed on the cloth walls through holes in the side of a line of quarter-inch copper tubing. Fourteen emergence cages were stacked on tables, and there was a movable electric light to facilitate collecting. Last, the vacuum collector was arranged with rubber hose of sufficient length to permit a special collecting tube to reach any corner of the insectary.

We are pleased to report that, in 1931, the wasp was recovered in the sugarcane fields, making it certain that it had completed at least one generation under field conditions in Louisiana.

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PRESIDENT J. S. HOUSER: The next paper is by J. S. Ingram and W. A. Douglas.

NOTES ON THE LIFE HISTORY OF THE STRIPED BLISTER BEETLE IN SOUTHERN LOUISIANA

By J. W. INGRAM and W. A. DOUGLAS, *Bureau of Entomology, U. S. Department of Agriculture*

ABSTRACT

The life history of *Epicauta lemniscata* Fab. (order Coleoptera, family Meloidae) is given for southern Louisiana.

The soybean is the principal leguminous crop grown in southern Louisiana. It is grown for forage, and for green manure in rotation with rice, sugar cane, and other crops. When first introduced in this section, the soybean apparently had no important insect enemies. However, the number of striped blister beetles present at that time increased and soon the species became an important soybean pest.

The striped blister beetle, *Epicauta lemniscata* Fab., has, in addition to soybeans, caused serious injury to the foliage of sweet pepper, tomato, Irish potato, and cabbage plants. It has also been found feeding upon rice, corn, a weed in the rice field commonly called indigo, lily, snap bean, mustard, egg plant, carrot, and a small sedge (commonly called "nigger wool"). The increasing importance of the beetle as a soybean pest led to a study of its life history.

The adult blister beetle is a light tan in color and has three black stripes extending the entire length of each wing cover. Underneath, it is uniform brownish black. The adult measures from 12 to 17 mm. in length and 3 to 4 mm. in width. The beetle is capable of giving forth a blistering fluid from the joints of the legs when disturbed.

As a rule the beetles make their first appearance in May or June. Their earliest recorded appearance was on May 8. It is evident that they emerge from the ground in widely scattered places. They soon collect in a body in soybean fields. Such groups have been found on grasses or in other places prior to entering soybean fields. When first observed in soybean fields the beetles are in droves, often being so thick on the plants as to cover completely the leaves and branches, giving the appearance of a swarm of bees. They move across the fields *en masse*,

devouring the bean foliage in their path. After several days in the bean field the beetles begin to scatter out over the field or to adjoining areas. If allowed to remain undisturbed, beetles are usually present for three weeks or more before disappearing. They move about mainly by walking. They fly but little, and principally at night.

After about a week or more of feeding, oviposition begins. The female beetle digs a hole in the ground about 1½ inches deep. The entrance is just large enough to accommodate the beetle, but the bottom of the hole is enlarged into an oval-shaped chamber. In this chamber the yellow, elongated eggs are deposited. Following oviposition, the beetle seals up the entrance. The number of eggs deposited in a single cell is usually over a hundred and as many as 187 have been found in one cell. Eggs have been deposited as early as June 20 and as late as October 14. Beetles, when confined, often lay their eggs upon the surface of the soil. When poisoned, female beetles often oviposit on the leaves of their host plant, in cracks in the ground, or on the surface of the ground, evidently in a hasty effort to reproduce their species before death. Because of fungi, very few, if any, of these eggs hatch.

From seven to ten days are usually required for the eggs to hatch, although as long as 26 days have been required in October. Eggs have hatched as late as November 9.

The eggs hatch into triungulin larvae. These are from 2½ to 3 mm. in length by about ¾ mm. in breadth. The larva has a large brown head with strong jaws, and a lighter brown segmented body, tapering toward the caudal end. It has strong legs and great endurance, some specimens having lived as long as fifteen days without food. When first hatched the larvae huddle together. They soon scatter out in search of food and have been found long distances from where adults were seen. Larvae have been found in the field as late as October 28. The only food, thus far found, of the triungulin is grasshopper eggs. Beetles have been reared on eggs of three different species of grasshoppers. When a grasshopper egg pod is found the hungry triungulin bores through the spongy layer covering the eggs, and begins feeding. Within a few days it changes to a larva resembling those of the Carabidae. This larva continues to feed upon the grasshopper eggs. In about seven days it transforms to a fleshy larva resembling those of the Scarabaeidae.

The scarabaeoid larva remains in this stage for about eight days. It then bores down from one to two inches beneath the former grasshopper egg pod. In the summer, under favorable weather conditions,

it forms a cell and changes to a pupa. The pupa rests in an upright position, usually from three to four inches beneath the surface of the ground.

In the late fall or under other undesirable conditions for the completion of the life cycle, the scarabaeoid larva, after boring down beneath the former grasshopper egg pod, changes to a coarctate larva or pseudopupa. This stage is a rigid footless form. It is yellow to brown in color, and ranges from 8 to 14 mm. in length. It is in this stage that the beetle hibernates.

The following spring the coarctate larva changes to a scolytoid larva. This stage resembles the scarabaeoid larva, being very fleshy and sluggish. Although provided with grasshopper eggs we have not found this stage to feed. The length of the scolytoid larval stage is from 11 to 21 days. At the end of this period it changes to a pupa similar to the summer form. In the field the usual emergence of beetles following a rain gives rise to the belief that the pupa stage is prolonged in dry weather until a rain or that the very hard dry soil delays the adults in coming out. Adults have been known to remain in glass tubes, that were filled with soil, as long as five days before digging their way out. The total length of the life cycle is from 35 to 50 days in summer. There are as many as three generations a year, and there is apparently an overlapping of generations due to weather conditions.

It is doubtful if the cold weather of winter kills any of the coarctate larvae in this section. Heavy rains which cause the soil to become soaked doubtless kill the beetle stages in low places in the ground. All of the sedentary stages of the blister beetle are found in greatest numbers in rice levees, tops of bean rows, and other elevated places. The Biological Survey has found that the meadowlark, the bluebird, and the scissor-tailed flycatcher feed upon the striped blister beetle. A robber fly, *Dizonias tristis* Walker, has been observed to seize the beetles, insert its proboscis in the back after spreading the wings apart, and suck out the body fluid. This robber fly is not present in large enough numbers to be of much assistance in controlling the beetle.

The adults and larvae are attacked by a white fungus determined as *Botrytis delacroisii* pro tem. by Miss Vera K. Charles. The eggs are attacked by another fungus determined as *Aspergillus, A. ochraceus* group, by Miss Charles. In the field no exposed eggs have been observed that were not destroyed by this fungus.

Observations on the life history of the blister beetle were facilitated by the use of glass observation tubes ⅜ of an inch in diameter

and about six inches long. These tubes were open at both ends. A single beetle stage was placed in soil in each tube with food added when desired. The tubes were then pushed downward into soil in earthenware jars. The condition prevailing inside the tube closely resembled that in the outside soil. The tube could be pulled out at any time and the beetle stage observed through the glass. The tube could then be returned to its former position in the jar without disturbing the development of the various stages. It was found that the beetles emerged in the same length of time in tubes as when they were not so confined.

The authors are indebted to Mr. T. E. Holloway, in charge of these investigations, and to Mr. J. M. Jenkins, Superintendent of the Rice Experiment Station at Crowley, Louisiana, for aid and suggestions in collecting the data herein reported.

Adjournment 3:50 p. m.

Wednesday Morning Session, December 30

The session convened at 10:20 a. m., President J. S. Houser, presiding.

PRESIDENT J. S. HOUSER: We will now hear a paper by C. R. Cutright.

SMALL PLOTS IN CODLING MOTH FIELD EXPERIMENTS

By C. R. CUTRIGHT

The present technique used in field experiments with codling moth calls for the expenditure of a tremendous amount of time and labor and, at the end of the season, may result in the production of a pitifully small set of figures of more or less doubtful significance. Large plots, which have caused this condition, have come into use for two reasons: First, to eliminate as far as possible migration of moths from plot to plot and thus correct the subsequent equalization of injury that might follow; second, to smooth out the great variations of infestation that may be found between samples from the same plot.

During the past few years, the demand for accurate field data concerning the effectiveness of different materials for codling moth control has increased to such an extent that the present expenditure of time and labor on large size plots is entirely inefficient.

For some time the writer has considered the possibility of reducing the size of plot and still retaining accuracy by means of additional replication. It is not likely that such a plan would function everywhere, but for Ohio it seemed feasible. This season, a small orchard of uniform

trees was secured and laid out to test this idea. Plots of one tree were used, and these were replicated five times, each plot being located at random. If such a method proved accurate, the advantages of being able to secure data from five trees at random instead of from two plots of 25 trees each are quite obvious. However, the gains secured by this method must be measured against certain disadvantages. It is, therefore, proposed to list these disadvantages and to answer each in the light of our observations and data of the past year.

The objections with solutions are:

1. Small plots render the mechanics of spraying too difficult. In reply to this objection, it must be remembered that with this plan, the necessary amount of spraying is greatly reduced; hence this difficulty is not an important objection. However, all trees must be plainly marked to guard against mistakes in spraying.

2. Results may be made unreliable by spray drift, etc. This objection may be met, in Ohio at least, by selecting calm days for spraying or by spraying in early morning or in the evening. The fewer trees used aid greatly in this procedure.

3. Due to the few trees and consequently to the smaller amounts of fruit, samples large enough for accuracy cannot be obtained. Objection 3 is readily admitted, but there are ways of greatly increasing the accuracy of sampling that may be used to overcome this; for example, the collection and scoring of dropped fruits. In this experiment all dropped fruits were collected and examined at 10-day intervals, commencing at July 15. All collections taken prior to Sept. 10 are designated as pre-harvest drops, and the arithmetic means of the collections for the different materials may be compared directly for significance. The drops from Sept. 10th to the time of fruit harvest are designated as harvest drops, and similar comparisons may be made. At picking time, adequate samples of the picked fruit are examined and the results are treated likewise.

Ordinarily records on picked fruit only are taken, but with this plan there are three figures, each representing the condition of the crop at a certain stage and each of definite interest as concerns the final evaluation of the spray material. Time does not permit the presentation of the detailed records that were secured from the experiment of this year. However, it can be stated definitely that the data so collected are entirely coherent and well within the range of possible variation when compared with data of the usual type. Table 1 illustrates the agreement of figures taken from one plot in each similarly treated series with he combined figures of all replicates. It also gives an idea of the value

of having three figures to represent the condition of fruit in each plot as compared with having only one figure.

TABLE 1. CODLING MOTH INJURY AT DIFFERENT PERIODS OF THE GROWING SEASON SHOWING COHERENCE OF DATA

Single Tree Data				All Trees Totaled			
Plot	Pre-harvest Drops	Harvest Drops	Picked Fruit	Material	Pre-harvest Drops	Harvest Drops	Picked Fruit
1A	4.5	24.0	14.5	1	4.7	19.9	9.0
2A	88.3	92.4	50.5	2	82.2	86.6	38.5
3A	96.6	83.4	50.5	3	86.9	83.8	33.4
4A	85.7	88.1	33.1	4	80.0	82.0	33.6
5A	13.8	18.2	13.1	5	12.2	27.3	12.8

It may be further objected that the scattering of plots at random through the orchard will tend to increase the variability of the samples. Table 2 shows the comparison between variability in the one-tree plot system and the large-plot system of grouped record trees. This certainly would indicate that there is no great difference in this respect between the two plans. However, it should not be inferred that one-tree plots should be scattered over large orchards where known areas of different degrees of infestation exist unless the process of replication is increased to cover such conditions.

TABLE 2. COMPARISON OF VARIABILITY OF CODLING MOTH INJURY

Trees in Groups Per cent Injury on Picked Fruit					Trees Scattered at Random Per cent injury on Picked Fruit				
1	2	3	4	5	1	2	2	4	5
21.8	—	21.6	15.3	27.2	14.5	50.5	50.5	33.1	13.1
28.6	18.5	18.7	26.2	23.7	7.3	37.4	26.5	33.9	16.5
20.0	12.0	20.9	27.8	17.5	7.1	36.5	30.5	27.1	13.4
42.7	15.5	41.5	37.9	13.6	10.0	30.7	43.7	41.0	11.2
—	—	—	—	—	5.5	30.3	37.2	33.9	10.1
—	—	—	—	—	—	—	—	—	—
14.4	3.2	15.8	11.1	6.9	6.2	13.4	12.8	7.2	3.6
Max. d. m.									

4. Migration of moths from heavily infested plots in late season will interfere with true results on adjacent plots. Such migration may be corrected: First, by the scoring of pre-harvest drops which will indicate clearly the materials that are failing to control at that season; and second, by the application of extra sprays later than normal. Each series of plots should be sprayed with the same material as was used in previous applications. The good materials will, in large part, prevent establishment of worms from the migrating moths, whereas poor materials will certainly not correct the infestations already present on such plots. In our series of plots this year, the counts from early drops showed quite clearly that certain materials were failing to control and that a heavy moth flight from these plots might be expected. To

preserve the *status quo* of all the plots, the series received an extra spray on August 8 about 2 weeks after the one regular midsummer application. The figures in Table 1 will testify that the desired results were secured.

Although the data presented may not cause radical changes in our system of field experimentation, it is thought that the plan is worthy of further trial. In any event the writer expects to use it to some extent, hoping thereby to gain a little time in which to ponder the deep philosophies inherent in entomology.

PRESIDENT J. S. HOUSER: The next paper will be read by S. W. Frost.

NOTES ON THE CONTROL OF THE CODLING MOTH[1]

By S. W. FROST, *The Pennsylvania State College*

ABSTRACT

Control experiments against the codling moth (*Carpocapsa pomonella*) covering a period of eight years are summarized. It is evident from these experiments that the fourth spray (the so-called codling moth or petal-fall application) is not as effective as the following spray. A few notes are included on the effectiveness of poisons other than arsenate of lead.

The figures on codling moth presented herewith were secured during spraying and dusting experiments directed against other insects, chiefly bud moths and leaf rollers and hence the initial infestation of codling moth is frequently low. It is difficult to gather notes on the control of any insect covering a number of years, as the method of operation and of interpretation naturally changes as the work progresses, and the crop of fruit varies from year to year. In order to keep the work as nearly uniform as possible, orchard records of operation were kept on four by six inch index cards, one of which is shown on page 78.

MANNER OF CONDUCTING EXPERIMENTS. All tests were conducted in blocks of York, stamen or black twig of not less than fifty trees. Spraying was done with two leads of hose, one from the ground and one from the tower. There was no uniformity as to type of sprayer or duster, for the work was done in a large number of different orchards, using machines available. The spraying was done with at least 250 pounds pressure. A few explanations regarding Table 1 will help to interpret the results. For conciseness, also to correspond with the schedule recommended by the Spray Service of the Pennsylvania State College,

[1]Publication authorized by the Director of the Pennsylvania Agricultural Experiment Station as Technical Paper No. 549.

the sprays have been numbered representing stages in tree development as follows: 1 = dormant; 2 = delayed dormant; 3 = pink; 4 = petal fall; 5 = an application approximately 10 days after the petal fall; 6 = an application approximately 3 weeks after petal fall; and 7 = an application approximately 9 weeks after petal fall. The materials indicated in column 2 of Table 1 were used in all sprays throughout the summer, for example, where nicotine is indicated, it was used in all sprays. The number of fruits indicated is the total number of fruit from which the percentage of injury was calculated. In most cases drop fruit was gathered five or six times during the summer from June 1 to picking time.

THE 4 x 6 RECORD CARD USED IN COMPILING SPRAY AND DUST OPERATIONS

Plat I

Farm.....*D. N. Minnick*..... Project.....*636*.....

Location.....*Biglerville, Pa.*..... Date.....*April 22, 1921*.....

Crop.....*Apple*..... Variety.....*York & black twig*.....

Treatment.....*Petal fall*..... Condition of Crop.....*petals 2/3 off*.....

Preparation.....*5:30 A. M. to 5:36*.....

Operation, time.....*5:36 to 5:52 A. M.*..... Men.....*2*.....Horses.....*2*.....

Application, machine.....*Niagara*..... Pressure.....*duster*..... Nozzle.....

Materials.....*Sulphur 90%*.....*A. lead 10%*.....*nicotine sulphate*.....*1.9%*.....

Dilution.....*87½ lbs., used*.....

Notes.....*Dust hanging very well in trees. Very little wind stirring. Dusted both sides of the trees.*

The 4th (petal fall application) was omitted in one series and applied in the other in tests; 5, 8, 27 and 28. In all cases, the percentage of codling moth injury was approximately the same whether the 4th application was applied or omitted.

The 5th application was omitted in one series and applied in the other in tests 2, 3, 9, 10 and 12. In all cases the percentage of codling moth injury was approximately the same or slightly less where the 5th application was added. Unfortunately the 5th application was applied ten or twelve days after the 4th. By moving the 5th application to seven days after spray number 4, as was done in tests 27 and 28, the percentages of codling moth injury were considerably reduced.

Comparisons of sprays and dusts appear in tests 1, 2, 4, 6, 7, 10, 12, 14, 16, 17, 18, 20, 22, 23, 24 and 26. In only three cases dust gave slightly better kill than sprays. In four cases, the percentage of injury

was approximately the same in dusted and sprayed plots. In eight cases, spray applications gave better control than dust.

Nicotine was used in some liquid and dust applications throughout the season. Nicotine in combination with sulphur and arsenate of lead dust gave no additional killing effects (tests 6 and 7). Nicotine in combination with Pyrox (test 4), also a 2 per cent nicotine-lime dust (test 19) apparently held the codling moth in check.

Calcium arsenate was used in tests 4, 22 and 24, while magnesium arsenate was used in test 11. Both compared favorably with arsenate of lead as a control for codling moth. Magnesium arsenate gave no burning in combination with lime sulphur. The analysis of the magnesium arsenate follows: Mg_3 (AsO_4), more than 50 per cent; inert ingredients, less than 50 per cent; total arsenate oxide (As_2O_5), more than 33 per cent; total arsenic as metallic, more than 21.50 per cent; water-soluble arsenic oxide (As_2O_5), less than .75 per cent; water-soluble arsenic as metallic, less than .49 per cent.

The copper dust used in tests 14, 22 and 24 contained not less than 19.5 per cent monohydrated copper sulphate and not less than 17.5 per cent of tricalcium arsenate.

Spreaders were used in combination with various sulphur sprays in Tests 17 and 25. A slight reduction in percentage of codling moth injury resulted where they were used.

SUMMARY OF SPRAYING AND DUSTING EXPERIMENTS AGAINST THE CODLING MOTH

	Applications 1 2 3 4 5 6 7	Materials	Picked Fruit Number	Picked Fruit Per cent	Drop Fruit Number	Drop Fruit Per cent
Test 1	x x x x x	Lime sulphur+A. lead	26,020	.04	754	2.40
1917	x x x x x	Dust, sulphur+A. lead	22,071	.00	890	2.70
Test 2	x x	Lime sulphur+A. lead	1,478	.70	——	——
1917	x x x	Dust, sulphur+A. lead	5,269	.30	——	——
	x x x	Dust, sulphur+A. lead	4,985	.20	——	——
	x x x	Dust, sulphur+A. lead	2,957	.30	——	——
Test 3	x x	Bordeaux A. lead	2,304	4.20	73	52.00
1918	x x	Lime sulphur+A. lead	2,195	3.80	37	22.20
	x x x	Lime sulphur+A. lead	1,076	4.40	90	15.00
	Check	No application	2,251	5.20	90	75.50
Test 4	x x	Lime sulphur+A. lead	623	1.50	451	2.80
1919	x x x	Sulfocide+Ca. arsenate	2,584	.90	——	——
	x x x	Pyrox+Nic. sulphate	1,617	.35	681	1.00
	x x x	Lime sulphur+A. lead	1,159	.30	576	.52
	x x x	Dust, sulphur+A. lead	568	.70	1,401	1.14
	Check	No application	4,595	3.63	——	——

SUMMARY OF SPRAYING AND DUSTING EXPERIMENTS AGAINST THE CODLING MOTH—*Continued*

	Applications 1 2 3 4 5 6 7	Materials	Picked Fruit Number Fruit	Picked Fruit Per cent	Drop Fruit Number Fruit	Drop Fruit Per cent
Test 5 1919	x x x x x	Bordeaux, A. lead	1,726	.57	67	1.49
	x x x x	Pyrox	1,825	.87	266	4.51
	x x x	Lime sulphur+A. lead	2,161	.46	210	2.38
	x x	Lime sulphur+A. lead	2,438	1.50	830	5.10
	x	Lime sulphur+A. lead	906	6.84	431	15.80
	Check	No application	200	10.60	538	10.50
Test 6 1920	x x x x x	Lime sulphur A. lead	3,573	.30	14,513	.85
	x x x x x	Dust, 90–10+½% nicotine	3,117	.40	4,396	2.60
	x x x x x	Dust, 90–10+1% nicotine	7,535	.40	10,523	.60
	x x x x x	Dust, 90–10+3% nicotine	2,414	2.36	5,476	1.28
	Check		2,295	6.55	9,493	5.00
Test 7 1920	x x x x x	Lime sulphur+A. lead	2,335	.2	840	1.9
	x x x x x	Dust 90–10+½% nicotine	1,469	1.4	1,319	3.5
	x x x x x	Dust 90–10+1% nicotine	3,721	7.5	1,364	1.8
	x x x x x	Dust 90–10+3% nicotine	1,829	1.0	3,332	1.4
	Check	No application	1,570	15.0	273	24.1
Test 8 1930	x x x x	Lime sulphur+A. lead	300	4.6	——	——
	x x x x x	Lime sulphur+A. lead	1,118	5.2	683	1.4
	x x x x	Lime sulphur+A. lead	911	6.3	94	.0
	x x x	Lime sulphur+A. lead	2,540	1.8	910	1.9
	Check		2,503	35.5	1,109	1.6
Test 9 1920	x x x x	Lime sulphur+A. lead	1,462	8.6	1,638	.1
	x x x	Lime sulphur+A. lead	1,422	8.9	211	.9
	x x	Lime sulphur+A. lead	1,752	10.1	867	.4
Test 10 1920	x x x x	Dust 90–10	2,221	8.6	581	19.4
	x x x x x	Lime sulphur+A. lead	1,354	7.7	666	15.0
	x x x x	Lime sulphur+A. lead	1,318	11.3	1,087	10.6
	x x x x x	Dust 90–10	1,738	14.5	1,497	6.3
	Check	No application	1,263	25.6	1,452	25.4
Test 11 1920	x x	Lime sulphur+A. lead	1,638	2.5	1,119	1.9
	x x x	Lime sulphur+Mg. arsenate	1,822	1.9	572	4.7
	x x x	Lime sulphur+A. lead	2,286	.7	1,077	2.3
	x x x x	Lime sulphur+A. lead	2,025	.59	1,065	.5
	x x x x x	Lime sulphur+A. lead	1,956	.7	333	1.5
	Check	No application	1,607	26.1	2,144	27.9
Test 12 1920	x x x x x	Dust, 90–10	2,325	3.22	——	——
	x x x x x	Lime sulphur+A. lead	1,560	.64	——	——
	x x x x	Lime sulphur+A. lead	1,718	1.70	——	——
	Check	No application	1,693	16.90	——	——
Test 13 1921	x x x x x	Lime sulphur+A. lead	1,992	8.0	1,540	38.4
	x x x x x	Lime sulphur+A. lead	1,549	8.3	904	35.5
	x x x	Lime sulphur+A. lead	1,460	28.6	1,425	63.1
Test 14 1921	x x x x x x	Lime sulphur+A. lead	1,559	5.1	5,839	39.5
	x x x x x x	Lime sulphur+A. lead	1,673	7.6	3,231	25.4
	x x x x x x	Soluble sulphur+A. lead	1,530	11.1	1,808	50.0
	x x x x x x	Dust. copper+lead	1,447	11.1	4,003	68.4
	Check	No application	1,474	26.2	4,634	79.6

SUMMARY OF SPRAYING AND DUSTING EXPERIMENTS AGAINST THE CODLING MOTH—

Continued

	Applications 1 2 3 4 5 6 7	Materials	Picked Fruit Number	Picked Fruit Per cent	Drop Fruit Number	Drop Fruit Per cent
Test 15 1921	x x x	Lime sulphur+A. lead	52	26.9	——	——
	x x	Lime sulphur+A. lead	370	20.0	——	——
	x	Lime sulphur+A. lead	292	13.8	——	——
	Check		6	66.6	——	——
Test 16 1921	x x	Lime sulphur+A. lead	690	9.1	——	——
	x x	Dust	717	7.3	——	——
	x x	Dust	652	9.2	——	——
	Check		65	16.9	——	——
Test 17 1922	x x x x x	Dust, sulphur+A. lead	1,445	.7	——	——
	x x x x x	Pyrox	981	.3	——	——
	x x x x x	L. S. A. lead no spreader	1,176	.1	——	——
	x x x x x	L. S. A. lead with spreader	1,373	.2	——	——
	Check		43	2.3	——	——
Test 18 1922	x x x x x	Dust 80–10–10	1,073	.2	138	9.3
	x x x x x	Lime sulphur+A. lead	858	.4	119	5.8
Test 19 1922	x x x	Dust-lime+2% nicotine	1,806	.4	1,114	15.6
	x x x	Dust 90–10 no lead 2% nicotine	1,205	2.3	1,146	16.1
	x x x x	Dust 90–10 no lead nor nicotine	1,553	1.9	1,234	20.3
Test 20 1922	x x x x x	Dust, sulphur+A. lead	1,270	.6	1,756	22.1
	x x x x x	Lime sulphur+A. lead	1,672	2.3	1,316	17.1
	Check	No application	908	5.3	270	42.5
Test 21 1922	x x x x	Lime sulphur+A. lead	1,128	.7	138	1.4
	x x x	Lime sulphur+A. lead	690	1.3	55	7.2
	x x x	Lime sulphur+A. lead	147	.0	47	.0
	Check	No application	53	.0	11	9.0
Test 22 1922	x x x x x	Dust, copper+Ca. arsenate	1,265	1.1	1,153	3.2
	x x x x x	Lime sulphur+A. lead	1,662	.7	862	1.7
	x x x x x	Dust 90–10	1,314	.6	1,242	1.5
	x		——	——	189	11.6
Test 23 1922	x x x x x	Lime sulphur+A. lead	1,340	.0	410	.7
	x x x x x	Dust 80–10–10	1,067	.0	88	3.4
	Check	No applications	925	1.5	38	7.8
Test 24 1922	x x x x x x	Lime sulphur+A. lead	2,614	.6	2,009	11.2
	x x x x x x	Dust copper+Trical. ars.	2,316	1.5	2,168	16.5
	x x x x x x	Dust, sulphur 90–10	3,312	.7	2,288	12.4
	Check	No applications	2,942	4.5	1,164	40.4
Test 25 1922	x x x x x	Prec. sul.+A. lead	1,086	.9	——	——
	x x x x x	Dry mix+A. lead	1,052	.1	——	——
	x x x x x	Coll. sul. Kayso+A. lead	1,176	1.2	——	——
	x x x x x	Lime sul. Kayso+A. lead	1,207	1.8	168	32.7
	x x x x x	Lime sulphur+A. lead	1,035	2.2	167	45.5
	x x x x x	Lime sulphur, Kayso+A. lead	1,427	.8	305	32.4
	Check	No applications	1,023	5.8	74	43.2

SUMMARY OF SPRAYING AND DUSTING EXPERIMENTS AGAINST THE CODLING MOTH—

Continued

	Applications 1 2 3 4 5 6 7	Materials	Picked Fruit Number Fruit	Picked Fruit Per cent	Drop Fruit Number Fruit	Drop Fruit Per cent
Test 26	x x x x x x	Lime sulphur+A. lead	415	.7	——	——
1923	x x x x x	Lime sulphur+A. lead	170	.0	——	——
	x x x x x	Lime sulphur+A. lead	707	.2	——	——
	x x x x x x	Lime sulphur+A. lead	1,093	.9	——	——
	x x x x x x	Prec. sul.+A. lead	1,202	.2	87	5.7
	x x x x x x	L. S. no lead until June 20	1,260	.6	1,241	14.4
	x x x x x	Lime sul.+A. lead	1,059	.5	68	7.3
	x x x x x x	Dry mix+A. lead	906	.1	91	8.7
	x x x x x	Dust	347	1.1	68	7.3
	Check	No application	641	1.7	17	11.7
Test 27	x x x x	Lime sulphur+A. lead	1,906	58.5	629	21.1*
1930	x x x	Lime sulphur+A. lead	1,176	44.8	631	13.9*
Test 28	x x x x	Lime sulphur+A. lead	1,675	44.6	117	19.9*
1930	x x x	Lime sulphur+A. lead	1,582	32.7	232	6.5*

*Drops taken only at picking time.

CONCLUSIONS

(1) The omission of the 4th (petal fall application) resulted in little or no additional injury by codling moth.

(2) The omission of the 5th application resulted in considerably more injury by codling moth.

(3) Little difference was observed in codling moth injury in sprayed and dusted plots although slightly less injury occurred in the sprayed plots.

(4) A 2 per cent lime-nicotine dust without arsenate of lead held the codling moth in check.

(5) Calcium arsenate and magnesium arsenate were as effective as arsenate of lead in controlling codling moth. Magnesium arsenate in combination with lime sulphur caused no injury to the foliage.

MR. T. J. HEADLEE: I would like to inquire how the writer explains the efficiency of the spray put on a week or ten days after the petals fall.

MR. S. W. FROST: That is rather difficult to explain. I feel that we probably have a larger percentage of side injury and that we emphasize too much the treatment when the petals fall and not enough the spray that follows. That is the only answer that I can give to that question.

MR. F. A. FENTON: Under some conditions the petal fall spray was not uniform as to effect?

MR. S. W. FROST: I refer chiefly to the percentage of injury where we have a short crop and a fairly heavy infestation of codling moth. In all cases where the percentage was relatively low our figures show higher control with the later spray than where we put on the petal fall application.

PRESIDENT J. S. HOUSER: I would like to ask if you keep a record of the drops throughout the season.

MR. S. W. FROST: Practically all of the records have the drops included. One column lists the picked fruit and the other column the dropped fruit.

PRESIDENT J. S. HOUSER: The next paper is by F. H. Lathrop and R. F. Sazama.

A LABORATORY-FIELD METHOD FOR THE STUDY OF THE EFFICIENCY OF CODLING MOTH SPRAYS

By F. H. LATHROP and R. F. SAZAMA,[1] *United States Department of Agriculture, Bureau of Entomology.*

ABSTRACT

A method was developed for the study of codling moth (*Carpocapsa pomonella*) control which combines the use of both laboratory and field technique. A block of Red Delicious apples in a commercial orchard was selected for the orchard spray plots, and the applications were made by modern methods. The larvicidal efficiency of the spray coating on the fruit was studied throughout the season. Results of the treatments were also determined by observations of drops and of harvested fruits.

Data are presented showing results of the studies.

The practical improvement of codling moth control by means of insecticide applications depends to a considerable extent upon the advancement of knowledge of the factors that determine the efficacy of the treatments applied. With this in mind, an attempt was made at the Vincennes, Indiana laboratory, during the season of 1931, to develop a method for the study of codling moth control which would combine both laboratory and field technique, with the expectation that such a method might produce results that could not be obtained by either laboratory or field studies alone.

[1]The writers wish to express their appreciation to H. Plass and Sons, Decker, Indiana, for permitting the experimental work discussed in this paper to be done in their orchard. Much credit is also due the following temporary assistants of the Bureau of Entomology: J. M. Amos, G. H. Geissler, G. W. Jackson, M. M. McDowell and Charles Thorne.

Outline of Methods Employed

Spray Plots. For the orchard spray plots a block of Red Delicious apples located at Decker, Indiana was selected because of its apparent uniformity, its history of comparatively severe codling moth infestation in past years, and its general fitness for the purpose. The trees, planted

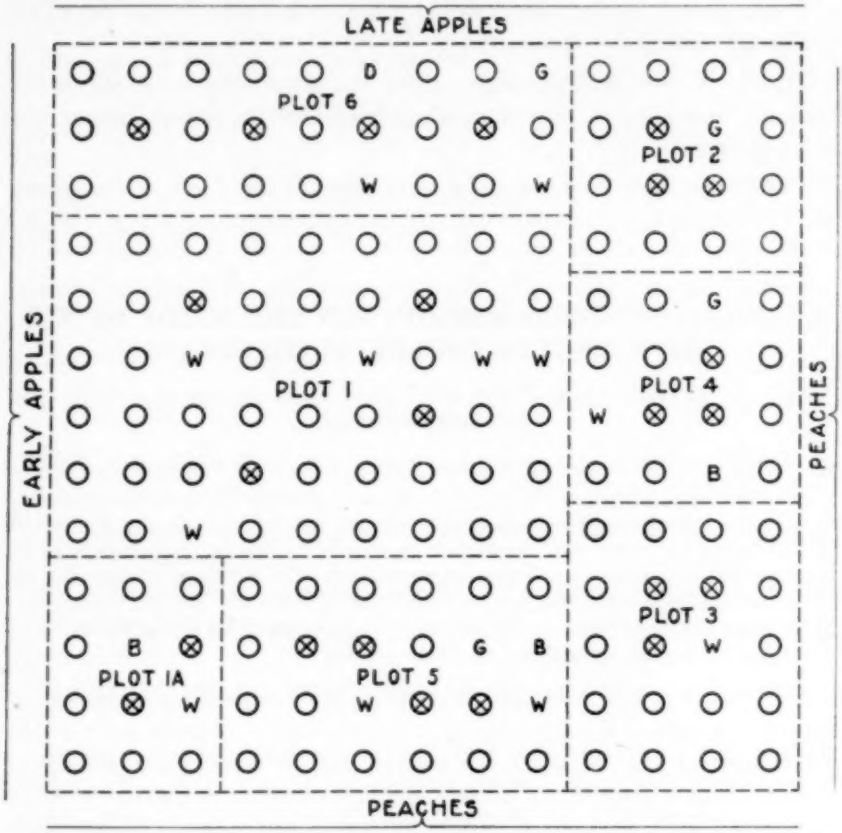


Fig. 1.—Diagram of Experimental Spray Plots: Circles indicate Red Delicious apple trees; crosses indicate count trees. Other varieties of apples are indicated as follows: B, Winter Banana, D. Golden Delicious, G. Grimes Golden, W, Golden Winesap.

30 by 30 feet, are 13 years old and about 25 feet in height. They have not been heavily pruned, with the result that they are rather too dense for ideal spraying. The soil is approximately level, with drainage toward the east. The layout of the experimental block is shown in Figure 1. It was appreciated in laying out the block that the test plots should have

been arranged in duplicate, and this has been emphasized by observations during the course of the work. However, in order to devote as much effort as possible to the development of technique, it seemed necessary to simplify the field work as much as possible this season, and the test plots were not duplicated.

All of the plots except No. 6 were sprayed by Mr. R. F. Sazama and Mr. G. H. Geissler of the Bureau of Entomology, using a power sprayer, which developed a pressure of 300 pounds. The trees were sprayed from the ground and from a tower on the sprayer, using a gun from both positions. The gun used was about 5½ feet long, with the end bent at a 30° angle, bearing a single nozzle. Every effort was made to give the trees as nearly ideal coverage as possible.

Plot No. 6 was sprayed by the regular spray crew employed in the orchard.

On the plots sprayed by the Bureau crew an average of about 8 gallons per tree was used in each application throughout the season. On plot 6, sprayed by the orchard crew, an average of about 4 gallons was used in the early applications, and increased to 6 gallons in the later applications.

The timing of the spray schedule was based largely upon records from bait traps operated in an orchard about one-fourth mile from the experimental block, and the sprays were applied as nearly as practicable at the periods of greatest effectiveness. The spray schedule for the season is shown in Table 1.

METHODS OF SAMPLING FOR LABORATORY TESTS. Samples of apples were taken from the experimental orchard on the following dates: June 3, 5, 9, 11, 16, 18, 22, 29, July 6 (before and after spraying), 8, 10, 14, 21, 27 (before and after spraying), August 3, 7, 11, 13, 15, 21, September 4 and 14. On each date 50 apples were taken from each plot under observation, except on June 3, when only 40 apples were taken. The apples were taken from several trees in each plot so as to have a satisfactory distribution and were picked from all sides of each tree from which samples were taken. All of the samples were picked by men standing on the ground. Every care was used to make the samples as truly representative of the plot as possible, and it was attempted to pick the individual apples entirely at random with respect to spray coverage.

Each apple was picked and brought into the laboratory without touching or disturbing the sprayed surface in any way. To do this, the following procedure was used:

A pin (consisting of a straight piece of 12 gauge galvanized iron wire 4 1/4 inches long, sharpened to a point at one end) was gently tapped into the calyx of the desired apple to a depth sufficient to impale the

TABLE 1. EXPERIMENTAL SPRAYS FOR CONTROL OF CODLING MOTH, IN RED DELICIOUS APPLE ORCHARD IN 1931

Plot	(1) Pre-pink (April 10 and 11) (2) Pink (April 13 and 14)	(3) Calyx (May 4)	(4) Special scab (May 15)	(5) First cover for first-brood codling moth (May 21)
All plots	Liquid lime sulphur 1 gallon Water to make 40 gallons	Liquid lime sulphur 1¼ gallons Lead arsenate 2 pounds Water to make 50 gallons	Liquid lime sulphur 1 gallon Water to make 50 gallons	Lead arsenate 1½ pounds Lime sulphur 1 gallon Water to make 50 gallons

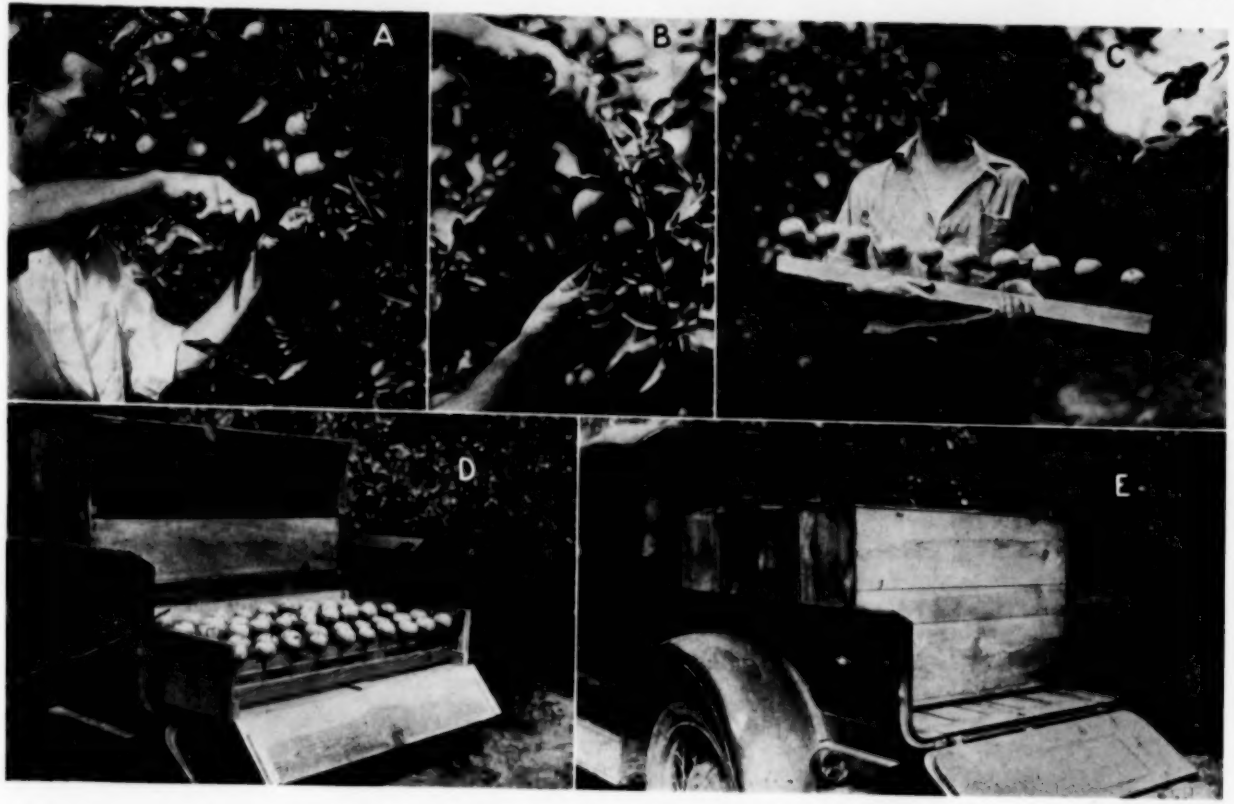
TABLE 1—*Continued*

Plot	(6) Second cover first-brood codling moth (June 2)	(7) Third cover first-brood codling moth (June 15)	(8) First cover second-brood codling moth (July 6)	(9) Second cover second-brood codling moth (July 27)	(10) Third cover second- and third-brood codling moth (August 12)
1 and 6*	Lead arsenate 1½ pounds Lime 3 pounds Water to make 50 gals.	Lead arsenate 1½ pounds Lime 3 pounds Water to make 50 gals.	Lead arsenate 1½ pounds Lime 3 pounds Water to make 50 gals.	Lead arsenate 1 pound Lime 2 pounds Water to make 50 gals.	Lead arsenate 1 pound Lime 2 pounds Water to make 50 gals.
1A	Lead arsenate 1½ pounds Water to make 50 gals.	Lead arsenate 1½ pounds Water to make 50 gals.	Lead arsenate 1½ pounds Water to make 50 gals.	Lead arsenate 1 pound Water to make 50 gals.	Lead arsenate 1 pound Water to make 50 gals.
2	Lead arsenate ¾ pound Lime 1½ pounds Fish oil 1 pint Water to make 50 gals.	Lead arsenate ¾ pound Lime 1½ pounds Fish oil 1 pint Water to make 50 gals.	Lead arsenate 1½ pounds Lime 3 pounds Water to make 50 gals.	Lead arsenate 1 pound Lime 2 pounds Water to make 50 gals.	Lead arsenate 1 pound Lime 2 pounds Water to make 50 gals.
3 and 5‡	Lead arsenate 1½ pounds Lime 3 pounds Water to make 50 gals.	Lead arsenate 1½ pounds Lime 3 pounds Wa er to make 50 gals.	Summer oil† 2 per cent	Summer oil 2 per cent	Summer oil 2 per cent
4	Lead arsenate 1½ pounds Lime 3 pounds Water to make 50 gals.	Lead arsenate 1½ pounds Lime 3 pounds Water to make 50 gals.	Summer oil† 1 per cent Nicotine sulphate (40%) 1:1600	Summer oil 1 per cent Nicotine sulphate (40%) 1:1600	Summer oil 1 per cent Nicotine sulphate (40%) 1:1600

*Plots 1 and 6 received the same treatment, except that plot 1 was sprayed by the Bureau of Entomology crew; and plot 6 was sprayed by the regular orchard crew.

†A commercial oil emulsion for use as a summer spray; the stock emulsion is said to contain approximately 65 per cent of oil having the following physical properties: Viscosity 80–85 seconds Saybolt at 100°F. Volatility 2.05. Unsulphonated residue 96 per cent (according to the De Ong method).

‡It was originally intended to make another application of summer oil on plot 5, but because of the decreased coloration of the fruit on the oil-sprayed trees, it was decided to omit the last application. Plots 3 and 5, therefore, received identical treatment.



Method used for collecting samples of apples in the orchard, and bringing them into the laboratory, without disturbing the spray coating: *A*. Tapping the wire pin into the calyx of an apple; *B*. Severing the stem of the apple; *C*. A "stick" of ten apples; *D*. A cabinet used for transporting the apples,—the upper drawer is shown, full of apples, ready to be placed in the cabinet; *E*. Two cabinets loaded with samples of apples, ready to go to the laboratory. The two cabinets, together, have a capacity of 300 apples.

fruit securely on the pin. The pin was then grasped firmly, and the stem of the apple was severed by means of pruning shears. The pin bearing the apple was then placed in a hole in a stick long enough to hold 10 apples. The stick bearing 10 apples was placed in a cabinet especially constructed to hold 150 apples in such a way as to prevent any disturbance of the residue during transit to the laboratory. The entire process is explained by the illustrations in Plate 1.

In the laboratory, a ring of sticky banding material was placed about the calyx of each apple to prevent the larvae from escaping via the supporting wire, and then 10 newly-hatched codling moth larvae were placed on each fruit. The infested apples were not disturbed for about 7 days, at the end of which time a careful examination was made to determine the percentage of larvae that had entered the fruit.

TABLE 2. SUMMARY OF RESULTS OF EXAMINATIONS OF DROPS AND HARVESTED FRUIT FROM ORCHARD PLOTS*

Plot	Spray material†	Total fruit examined (Number)	Average worms per apple (Number)	Apples wormy (Per cent)	Apples stung (Per cent)	Apples wormy and stung (Per cent)
1	Standard lead arsenate and lime	3,276	0.091	7.9	16.2	24.1
1A	Lead arsenate without lime	4,760	0.049	4.5	13.8	14.2
2	Lead arsenate and lime with fish oil in two first brood sprays	2,314	0.091	1.7	7.9	9.6
6	Same as plot 1 but sprayed by orchard crew	3,862	0.164	13.9	16.6	29.5
4	Summer oil with nicotine sulphate (3 applications)	4,872	0.076	6.9	7.4	13.4
3	Summer oil 2 per cent (3 applications)	3,675	0.142	12.3	8.3	20.3
5	Same as plot 3	3,131	0.177	14.8	12.2	26.9

*In taking the samples of apples for laboratory studies, no fruits were taken from the trees selected for making field determinations.

†See also schedule, Table 1.

In each series of samples taken on a given date, a check of 50 apples was included for comparison. The check apples were picked and brought into the laboratory in a basket. The spray deposit was removed by washing them in a 2 per cent solution of hydrochloric acid: The check apples were then impaled on pins and infested with 10 newly-hatched codling moth larvae, exactly as were the test fruits from the experimental plots.

The comparative efficacy of the treatments was determined by com-

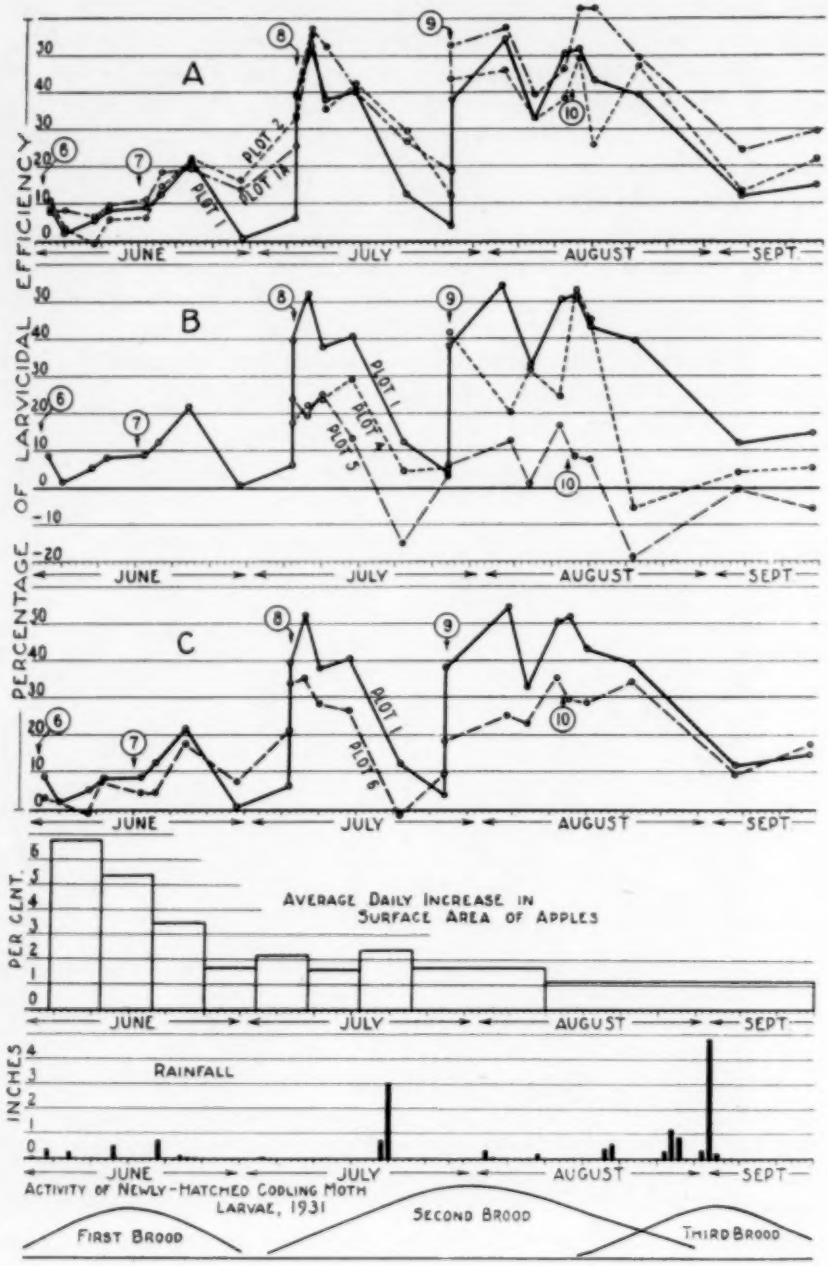

A
B
C
PERCENTAGE OF LARVICIDAL EFFICIENCY
PLOT 1
PLOT 2
PLOT 4
PLOT 5
PLOT 6
JUNE
JULY
AUGUST
SEPT
PER CENT.
AVERAGE DAILY INCREASE IN SURFACE AREA OF APPLES
INCHES
RAINFALL
ACTIVITY OF NEWLY-HATCHED CODLING MOTH LARVAE, 1931
FIRST BROOD
SECOND BROOD
THIRD BROOD

FIG.—2

paring the percentage of entrances in the test fruits with the percentage in the check fruits, using Abbott's formula.[2]

EXAMINATION OF FRUIT FROM SPRAYED PLOTS. At intervals during the season the dropped fruit was picked up from under designated trees in each plot, and the fruit examined for codling moth stings and entrances. When the fruit was picked at harvest time, all of the apples from the designated trees were examined, and the numbers of codling moth entrances and stings recorded.

DISCUSSION OF RESULTS

Results of the field examination of fruits from the sprayed plots are shown in Table 2, and the data from the season's study of larvicidal efficiency of the applications are shown in Table 3 and in Figure 2.

In considering Table 3 and Figure 2, it should be recognized that the data presented are limited to the larvicidal action of the spray residue on the fruit only. No indication is given of the possible larvicidal action of the spray on the foliage, or of the ovicidal action of the treatments. Neither do the data indicate the effectiveness of the residue in the calyx. It should be realized, therefore, that the study does do not present a complete picture of the effects of the spray applications. The data are interesting however when viewed as a record of the relative larvicidal efficiency of the spray deposits on the fruits at various dates throughout the season.

The lead arsenate and lime spray as applied to plot 1 may be taken as a standard for comparison, and is shown by a heavy solid line in Figure 2, A, B, C. The larvicidal efficiency of the spray coating on plot 1 was low during the period coinciding approximately with the activity of the first brood of the codling moth, and ranged from 0.7 per cent to 21.6 per cent, with an average efficiency of 8.2 per cent. Immediately before the application of the first cover spray for the second brood larvae, a test indicated a larvicidal efficiency of 6.2 per cent. A test made immediately after the application indicated a larvicidal efficiency of 39.8 per cent;

[2]Abbott, W. S. A Method of Computing the Effectiveness of an Insecticide. Jour. Econ. Ent., Vol. 18, pp. 265–267, 1925.

Fig. 2.—Graph showing the larvicidal efficiency of the spray coating on apples in relation to the increase in surface area of the apples, rainfall, and codling moth activity; A, comparison of arsenical sprays; B, comparison of summer oil and oil-nicotine sprays with the standard lead arsenate and lime spray; C, indicates the increased efficiency resulting from careful spray applications. The numbers in circles indicate the dates of spray applications, and refer to the schedule (Table 1).

an increase of 33.6 in the percentage as a result of the application. By the time of the second cover spray for the second-brood codling moth larvae, July 27, the larvicidal efficiency of the spray coating on the fruit of plot 1 had dropped to 4 per cent. As a result of the application, the efficiency increased to 38.2 per cent.

Following the application (No. 9) made on July 27, the larvicidal efficiency of the spray coating remained relatively high, and on August 11, the day before the last cover spray (No. 10), a test indicated an efficiency of 50.7 per cent. There was surprisingly little increase in larvicidal efficiency as a result of the last cover spray (No. 10), made on August 12, although this application of course prolonged the duration of the effective spray coating. During the period following the application of the last cover spray there was a decided decline in efficiency of the spray coating, to a large extent, no doubt, resulting from heavy rains.

TABLE 3. LARVICIDAL EFFICIENCY OF SPRAY COATING OF APPLES TAKEN FROM THE ORCHARD SPRAY PLOTS

Date	Percentage of entrances in check apples	Percentage of larvicidal efficiency						Remarks
		Plot 1	Plot 1A	Plot 2	Plot 6	Plot 4	Plot 5	
June 3	88.5	8.7	8.3	10.7	3.1			
5	83.6	1.7	8.4	3.1	1.7			
9	75.0	5.3	6.7	—0.3	—1.1			
11	86.6	8.1	9.7	5.8	7.5			
16	71.8	8.9	11.1	6.1	4.5			
18	80.6	12.6	18.6	14.9	4.5			
22	76.0	21.6	19.5	22.2	17.6			
29	56.4	0.7	13.8	16.3	7.5			
July 6	58.2	6.2	25.1	33.4	21.3	*	*	Before spraying
6	52.8	39.8	33.7	39.4	33.7	17.4	23.9	After spraying
8	53.6	52.2	57.5	56.0	35.4	22.0	19.3	
10	56.8	38.0	52.5	35.2	28.2	23.6	25.0	
14	56.3	40.7	40.7	42.8	26.7	29.3	13.3	
21	52.2	12.3	26.8	29.9	—1.5	4.6	—14.9	
27	65.6	4.0	19.2	12.1	9.8	5.2	3.3	Before spraying
27	60.4	38.2	53.0	43.7	18.5	42.0	6.0	After spraying
Aug. 3	59.8	54.5	57.9	45.9	25.4	20.4	12.7	
7	63.0	33.0	39.7	32.1	23.2	31.4	1.1	
11	54.8	50.7	46.7	38.3	35.4	24.8	16.7	
13	53.8	52.0	62.8	49.4	29.7	53.2	8,2	
15	59.4	43.3	63.0	26.3	28.6	7.7	45.1	See note †.
21	50.2	39.5	49.8	47.4	34.3	—5.2	—18.7	
Sept. 4	77.2	12.1	24.3	13.5	9.1	4.1	0.0	
14	72.2	15.0	29.9	21.6	7.4	5.5	—5.8	

*Plots 4 and 5 received the same treatment as plot 1 until July 6.

†It seems evident that in the case of samples taken on August 15 the data for plot 4 and plot 5 were inadvertently reversed. In the chart, Figure 2, the corrected data are used, but for all averages used in the discussion of results the data are used as shown in this table.

In studying the data from plot 1, a rather surprising effect may be noticed. The greatest larvicidal efficiency of the spray coating does not necessarily occur immediately after the application of a spray, but there is often an apparent increase in efficiency for several days after the application. This is well illustrated on the chart (Figure 2) following the application of sprays 7, 8, and 9. This effect is perhaps shown most distinctly in the case of plot 1, but it may be observed in several of the other plots also. It seems improbable that this effect is due entirely to experimental error, and yet it is difficult to account for it with certainty on any other basis without more data than are available at present.

A comparison of the arsenical sprays may be made from the data presented in Tables 3 and 4 and Figure 2, A. The addition of fish oil to the lead arsenate and lime spray for the first brood larvae increased the efficiency of the spray, as compared with the standard treatment (plot 1), even though only one-half the standard amount of lead arsenate was used. The average larvicidal efficiency in plot 2 during the first brood period was 12.47 per cent as compared to 8.2 per cent for plot 1 during the same period. In the second brood cover sprays, plots 1 and 2 received the same treatment, and the average efficiency is practically the same for the two plots (35.02 per cent in plot 1, and 35.57 per cent in plot 2).

TABLE 4. SUMMARY OF RESULTS OF LABORATORY TESTS OF APPLES TAKEN FROM THE ORCHARD SPRAY PLOTS

Period included	Average Percentage of Larvicidal Efficiency					
	Plot 1	Plot 1A	Plot 2	Plot 6	Plot 4	Plot 5
First brood (9 tests)	8.20	13.47	12.47	7.40	*	*
Second and third broods (15 tests)	35.02	43.83	35.57	23.59	19.07	9.01
Entire season (24 tests)	24.96	32.45	26.91	17.52	15.00	8.71

*Plots 4 and 5 received the same treatment as plot 1 during the first brood period.

The larvicidal efficiency of lead arsenate alone (plot 1A) proved distinctly greater than that of lead arsenate and lime (plot 1), as shown in Tables 3 and 4. Observations in the orchard showed that although there was no apparent injury to the fruit, considerable burning of the foliage on plot 1A apparently resulted from the application of lead arsenate alone. Injury to the foliage also developed on plot 1 to which lead arsenate and lime were applied. General observations in this section indicate that the foliage of apple trees in many orchards was not in a normal condition during the past summer, probably as an accumulated effect of drought and high temperatures during 1930 and 1931. Therefore, observations regarding injury from arsenical sprays should not be considered conclusive.

The larvicidal efficiency of the summer oil and oil-nicotine applications (plots 4 and 5) may be compared with the standard lead arsenate and lime spray (plot 1) in Tables 3 and 4 and in Figure 2, B. A glance at Figure 2, B, indicates that the tests of the larvicidal effects of the oil and oil-nicotine sprays (plots 4 and 5) are somewhat erratic as compared with the standard lead arsenate and lime spray (plot 1). The larvicidal efficiency of the 2 per cent summer oil spray was in general poor, and in two tests showed a distinct, negative effect. The average of all of the tests of plot 5 indicates 9.01 per cent larvicidal efficiency. The application of the oil-nicotine spray (plot 4) shows a higher larvicidal efficiency, the average (Table 4) being 19.07 per cent. When the average larvicidal efficiency for the season in plots 4 and 5 (Table 4) are compared with the results of the orchard examination of the fruits (Table 2), it will be noted that the orchard results indicate a much more satisfactory control than would be anticipated from the tests of larvicidal efficiency. The average larvicidal efficiency for the season in both plot 4 and plot 5 is distinctly inferior to that of plot 1. The field results (Table 2) indicate that, judged by the percentage of wormy and stung fruit, plot 5 is about equal to plot 1, and plot 4 is superior to plot 1. The discrepancy between the two sets of data is undoubtedly due to the superior ovicidal qualities of the oil and oil-nicotine sprays compared with the arsenical sprays. In connection with the summer oil spray it should be noted that, while the percentage of fruits showing worms and stings (plots 3 and 5, Table 2) compares favorably with the lead arsenate and lime spray (plot 1), the percentage of wormy fruit is distinctly greater in the summer oil plots than in the standard lead arsenate and lime plot.

TABLE 5. AVERAGE DAILY INCREASE IN SURFACE AREA
(MEASUREMENTS OF 500 APPLES)

Period from	Period to	Average daily increase in surface area (Per cent)
June 4	June 11	6.8
11	18	5.4
18	25	3.5
25	July 2	1.7
July 2	9	2.2
9	16	1.6
16	23	2.4
23	Aug. 10	1.7
Aug. 10	Sept. 21	1.1

EFFECT OF GROWTH OF APPLES UPON LARVICIDAL EFFICIENCY. In order to determine the effect of increase in surface area of the apples upon the larvicidal efficiency of the spray coating, measurements were

made of the diameters of a total of 500 apples on four trees in the experimental orchard at intervals during the season. In computing the areas, the apples were assumed to be perfect spheres. The average daily percentage of increase in the surface area of the apples is indicated in Table 5 and in Figure 2. The period of most rapid growth of the fruit coincides very well with the period of low larvicidal efficiency that occurred early in the season. During the greater part of the month of June, while the surface area of the apples was increasing rapidly, the arsenical spray applications failed to build up an effective coating on the fruit. This is in line with studies of arsenical residue in relation to growth of apples by Hamilton[3], who states: "The decrease in the arsenical residue upon the apples is also directly proportional to the increase in surface or volume growth." The decrease in efficiency of the spray coating as a result of the growth of the fruit was expected, but the effect is more striking than was anticipated. It should of course be borne in mind that larvae of the first brood appear to be especially susceptible to the effects of the spray coating upon the foliage and within the calyx, so that the total destruction of first brood larvae by insecticide applications is undoubtedly much more complete than the effectiveness of the spray coating upon the fruit itself indicates.

TABLE 6. RAINFALL IN EXPERIMENTAL ORCHARD DURING THE SPRAYING SEASON OF 1931

Date	Rainfall (inches)	Date	Rainfall (inches)	Date	Rainfall (inches)
April 23	0.64	May 30	0.37	July 20	3.03
25	0.04	31	0.05	Aug. 3	0.34
26	1.00	June 2	0.01	4	0.01
May 3	0.33	4	0.38	9	0.20
5	0.05	7	0.28	18	0.40
9	0.11	13	0.52	19	0.60
11	0.12	19	0.75	26	0.30
12	0.14	22	0.12	27	1.25
13	0.06	23	0.09	28	0.94
19	1.12	24	0.02	31	0.38
22	0.37	July 3	0.06	Sept. 1	4.86
25	0.76	19	0.73	2	0.21

EFFECT OF RAIN UPON LARVICIDAL EFFICIENCY. It is well known that rain is an effective agent in decreasing the arsenical spray coating on on apples. It would be expected, therefore, that rain would decrease the larvicidal efficiency of the arsenical sprays. The decrease in efficiency resulting from heavy rainfall in strikingly illustrated in Figure 2. (See also Table 6) Apparently scattered showers of less than 1 inch had

[3]Hamilton, Clyde C. The Growth of the Foliage and Fruit of the Apple in Relation to the Maintenance of a Spray Coating. Jour. Econ. Ent., Vol. 22, pp. 387–396, 1929.

little effect, but heavy rains of 3 inches or more produced a decided decline in the larvicidal efficiency.

The relationship of rainfall to the larvicidal efficiency of the oil and oil-nicotine sprays is not so clearly indicated by the data at hand.

Relation of Care of Application to Larvicidal Efficiency. The increased efficiency gained by careful spray application is illustrated in Tables 3 and 4, and in Figure 2, C. Plots 1 and 6 received identical treatment, except that plot 1 was carefully sprayed by trained men, while plot 6 was sprayed by the regular orchard crew. The average larvicidal efficiency of plot 1 throughout the season was 24.96 per cent, compared with 17.52 per cent for plot 6.

Reliability of the Method

In order to draw any conclusions from the foregoing studies, it is desirable to know something regarding the confidence that may be placed in the results of the tests. To determine the degree of variation within the samples, all of the apples used throughout the season, in the tests of plot 1, plot 5, and the check apples were studied. Each sample was divided into five equal parts, corresponding to the five "sticks" of 10 apples each, used in each test. The probable error of the mean percentage of entrances was determined for each sample, using each of the five "sticks" of 10 apples as a unit.

In plot 1 a total of 27 samples were thus analyzed. The mean percentage of entrances in only three of the samples was less than three times the probable error in each case. In all of the other samples the mean was at least three times the probable error, and in most cases it was many times greater.

The mean of each of the 18 samples from plot 5 was at least three times the respective probable error, and in nearly every case was many times the probable error.

Of the 25 samples of check apples, the mean of only one was less than three times the probable error, and most of the others were many times greater.

On September 3, triplicate samples of 50 apples each were taken from plot 1 and from plot 5, and a check series of 50 apples was used for comparison. The results are shown in Table 7.

The studies made during the season are based upon reasonably large samples of apples, and large numbers of larvae were used. The data collected in the entire study are based upon tests involving a total of 7,800 apples, which were infested with 78,000 newly-hatched codling moth larvae.

TABLE 7. RESULTS OF TESTS OF TRIPLICATE SAMPLES TAKEN SEPTEMBER 3

Series	Group*	Percentage of entrances	Percentage of efficiency
Check	1	72.6	—
Plot 1	1	63.6	12.4
	2	53.8	25.9
	3	56.0	22.9
Plot 5	1	75.6	— 4.1
	2	75.2	— 3.6
	3	70.2	3.3

*50 apples and 500 larvae used in each group.

On the whole, it seems that the method used gives a reasonable degree of accuracy, with results at least as reliable as the usual orchard spray-plot experiments.

SUMMARY

A method has been devised for the study of the larvicidal efficiency of codling moth sprays, by a combination of laboratory and field technique.

An experimental block, consisting of six plots, in a Red Delicious apple orchard was treated by means of modern spray equipment.

One plot was sprayed by the regular orchard spray crew, using lead arsenate and lime. The other five plots were sprayed by the Bureau employees. The treatments included lead arsenate and lime, lead arsenate without lime, lead arsenate with fish oil in two applications for first brood larvae, summer oil, and summer oil with nicotine for the second brood.

Results were determined by two methods: (1) The drops were collected and examined at irregular intervals and the picked fruit was examined at harvest time. (2) Samples of apples were taken from the spray plots at intervals throughout the season, and brought into the laboratory without disturbing the spray coating on the fruits. In the laboratory each apple was artificially infested with 10 newly-hatched codling moth larvae. The percentage of entrances in each sample from the sprayed plots was compared with the entrances in a series of apples from which the spray coating had been removed by washing them in 2 per cent hydrochloric acid solution.

The lead arsenate and lime spray was taken as a standard of comparison. The average larvicidal efficiency resulting from this treatment during the period of the first brood was 8.2 per cent; during the period of the second and third broods, it was 35.02 per cent; and during the entire season it was 24.96 per cent. The addition of fish oil to the lead arsenate and lime in the first brood sprays increased the larvicidal efficiency of the treatment somewhat, although only one-half the standard amount of

lead arsenate was used. Lead arsenate alone proved distinctly more efficient than lead arsenate and lime.

The larvicidal efficiency of the 2% summer oil spray was decidedly inferior to the lead arsenate and lime spray. Examination of the fruit from the orchard indicates that the deficiency in larvicidal effect is compensated for to a considerable extent by ovicidal action. In the orchard the summer oil spray was about as effective as the lead arsenate and lime spray when results are based upon the percentage of wormy and stung fruit. A larger percentage of wormy fruit resulted from the summer oil treatment, however, compared with the lead arsenate and lime spray. The larvicidal efficiency of the oil-nicotine spray was superior to that of oil alone, but was inferior to that of lead arsenate and lime. The orchard results show that the oil-nicotine spray was somewhat superior to lead arsenate and lime, probably as a result of the superior ovicidal effects of the oil-nicotine.

During the period of rapid growth of the apples—which coincided approximately with the period of activity of the newly-hatched larvae of the first brood of the codling moth—the arsenical sprays failed to build up an effective spray coating on the fruit. From a practical standpoint, this is probably compensated for to a large extent by the effects of the coverage on the foliage and in the calyx.

A sharp decrease in efficiency of the arsenical spray coating resulted from heavy rainfall.

A distinct benefit was derived as a result of careful spray application.

MR. C. M. CUTRIGHT: I should like to say in connection with Dr. Lathrop's statement regarding the efficiency of the cylinders in the field laboratory method, that we were doing some experimental work for a certain purpose. We had several glass cylinders that we sprayed with different materials. Then we took some young larvae and put them on these cylinders and left them on there for about twenty minutes, after which they were transferred to arsenic-free fruit and allowed to do as they wished. In reference to those cylinders which we had oiled, the young larvae after being on there for about twenty minutes were about the most discouraged looking creatures you ever saw. In fact, I had no idea that any would succeed in establishing themselves on unsprayed fruit. In spite of that fact, when they were put on the unsprayed fruit they established themselves in really remarkable fashion and at a remarkable rate.

MR. T. J. HEADLEE: I would like to inquire about the experience in the use of oil-lead. I judge from the statements of the speaker that he

had some experience with it. Is there any evidence of oil injury to the treated trees? Is there any correlation with the number of treatments, strength of treatments or the time of application?

MR. F. H. LATHROP: We did not use oil-lead in combination but did use oil-nicotine. With oil-nicotine and with oil alone, that is, 2 per cent oil alone or 1 per cent oil with nicotine 1 in 1600, we got a decrease in coloration of the fruit of selected apples. It was quite noticeable at harvest time. We did not notice any material foliage injury.

MR. T. J. HEADLEE: What was the viscosity of the oil that was used?

MR. F. H. LATHROP: I do not know. It was a commercial oil, an oil emulsion.

MR. G. L. HOCKENYOS: I should like to relate an experience I had and then ask a question. A young man who was working with me took a glass plate, fairly clean, and put a circle of droplets of oil upon that glass. He used some water white, rather viscous oil. He also had some oil in which he had violently odorous material, and some which gave a dark color to the oil. In the middle of the circle he put a lot of young hatched larvae and then observed their behavior. He found they would crawl toward the line of droplets. When they approached any of the droplets of oil that had a dark color or any odor they would immediately retreat. In the case of the pure, white oils, they would charge right into the droplets of oil and soon be killed.

Following that observation, we carried on some experiments in the laboratory on spraying apples, and we drew the conclusion that any emulsion which deposited the oil in fairly large droplets that stood up from the surface of the fruit was considerably more effective on the young larvae than an oil which was evenly spread very thinly in a film.

I should like to ask those present if they have had any experience which either substantiates or negates that experience we had.

MR. F. H. LATHROP: I do not know that we have had anything parallel with that but we tested the purely larvacidal effect of oils sprayed on apples and also as compared with the ovicidal effect. When the apples are sprayed with oil in the laboratory to get absolutely perfect coverage and young larvae are put on soon after the spraying has dried, the larvacidal efficiency is low. In our experience the oil never has much larvacidal efficiency. When codling moth eggs are deposited on apples and the apples are sprayed in the laboratory with oil, it has a very high ovicidal efficiency, 90 to 98 per cent in some cases. If the

apples are sprayed first and the eggs are deposited the ovicidal efficiency is much lower. In the field it looks as though the larvacidal efficiency, except for eggs present on apples, would be very low. There may be other factors, such as the decrease in the number of eggs deposited, or repelling of moths by the spray.

MR. S. C. CHANDLER: I would like to ask what the experience was with the droplets 24 hours after their application?

MR. G. L. HOCKENYOS: As nearly as I can recall, the observations were made a couple of hours after the droplets of oil were put on. In the case of the glass slides, we put on pure oil. In the case of the apples we were making a comparison of different types of oil sprays. We had the quick-breaking sprays which left the oil in visible droplets after the water dried out, and we had more stable sprays which left an even, thin film over the entire surface of the apple. It was the first type that produced the best results.

MR. S. C. CHANDLER: I wish to find out whether you would get the same results a day or two later.

MR. G. L. HOCKENYOS: I do not know.

MR. W. P. FLINT: There are several other factors which enter into oil spraying. In the laboratory we never have been able to secure an efficiency approaching that of arsenate of lead with the oil, while in the field we have never been able to equal the efficiency of arsenate of lead, though we have more nearly approached it there than we do in the laboratory. Another thing that enters in there in regard to the larvacidal effect is not the actual killing of the larvae but it has an effect on them that makes them uncomfortable and in a good many cases they wiggle about and roll off the apple. Of course, very seldom do they get back to it, though they do spin down.

PRESIDENT HOUSER: Is there any further discussion?

MR. T. J. HEADLEE: In two years' experience on the same block of apples we were able to get quite as good protection over a ten-day period with oil impregnated with Pyrethrum extract as we were able to obtain with lead arsenate. We used a white oil with a viscosity of 220, and that may account for the difference.

PRESIDENT HOUSER: Any further discussion?

This finishes the papers listed on the codling moth. The chair will give just a few minutes for further discussion of any one of these papers, if you so desire.

MR. T. J. HEADLEE: In our state, as I imagine in others, there is an oil-selling propaganda. There will be a lot of oil sold to our people. I am, therefore, very much interested in the effect of oil upon the foliage and fruit of the apple tree. I have considerable evidence to show that even with a low percentage of actual oil there is injury, varying kinds of injury, starting with what looks to be a stimulation where the foliage becomes greener and the fruit grows larger. The actual increase in leaf surface is greater for the first year. When the second year arrives it is found that the amount of fruit set upon the tree is materially reduced. The same greenness makes its appearance, and when the third season arrives the trees are generally pretty barren in the setting of fruit. That is one type of injury. It accumulates and goes on to the second and third year period. Then we have a type of injury which appears as a chlorosis of foliage and small fruit stems, resulting in the drop of a very considerable percentage of leaves and a drop of approximately half of the set fruit.

Then we have a third type of injury which appears as a burning of foliage, an actual burning, leaving large red spots and areas which later turn brown. This experience comes with a 220 viscosity oil, used at the rate of one-half of one per cent for the first type of injury and at one per cent for the second type. The first type of injury appears where the oil was applied eight successive times in each of two adjacent yards. The second type of injury made its appearance within one week of the first application which was made in June. The last experience, in 1931, was with the use of a commercial oil with a viscosity ranging from 80 to 85, lead and oil combined, on the first brood, in an orchard which was heavily infested, to my certain knowledge, with codling moths, with an astonishingly clean result in first brood control, no injury making its appearance.

Of course, some of those blocks received sprays for the second brood, and where that process was carried out it was with oil and arsenate and the removal of the residue was made much more difficult. It required a new process for its removal. That process was worked out.

A good deal of oil is coming to our state during the coming season and I am afraid of its effect upon the trees. Nobody is using more than .6 per cent actual oil, yet with that small amount of oil with the lead arsenate there is a very decided increase in the efficiency of the spray. I am interested in knowing all I can find out concerning injury of oil treatments to the apple foliage.

MR. W. P. FLINT: For the last six or seven years we have been carrying on rather extensive experiments with oil. We have always had injury when we put oil sprays on the trees for the first brood, early in the season. I don't think any oil ever used at that time failed to give injury. We have had results corresponding very closely to those that Dr. Headlee has reported as to increased efficiency with the oil lead combination. I know that it will be used by our growers a good deal this year. I don't think that in that combination it will be found safe to use more than .7 per cent of actual oil in the spraying. We have never used quite that much. Our maximum has been just about the same as Dr. Headlee's, between .6 and .7 per cent of actual oil.

MR. F. H. LATHROP: I should like to ask Dr. Headlee a question. I suppose he refers to the mineral oil and lead combination. I should like to ask if that is true entirely as applied to fish oil-lead combinations.

MR. T. J. HEADLEE: We have done no work with fish oil, but extensive work is being done and has been done in the state of Delaware by H. L. Dozier and by Stearns. The amount of fish oil used there is a quart to 200 gallons. That is, a pint to 100 gallons. Dozier reports absolutely no injury with fish oil. Stearns, from his experience, reports about 10 per cent increase in efficiency from the use of that amount of fish oil. He reports no injury from the use of fish oil. My own explanation for the lack of injury from fish oil is that it is due to the small amount of fish oil used. Our experience with animal and vegetable oils indicates that when our percentage of those oils is pushed up to any considerable extent we get injury from them.

MR. C. R. CUTRIGHT: I should like to say that we ran a series of tests on different amounts of fish oil incorporated in sprays. When we took the highest amount, something a little over half a gallon to 200 gallons, we rusted the fruit rather severely on spraying. I should like to ask what fungicide was used with this oil-lead combination.

MR. W. P. FLINT: There is only one fungicide that we could use with that sort of combination but if it is used you are likely to cause the spray to stick so tightly that it is extremely difficult to remove it. You will also have more or less difficulty with it sticking to the fruit, causing spotting and retarding fruit coloring. On this account we do not recommend any fungicide with that sort of combination.

MR. T. J. HEADLEE: We have some coppers that look fairly favorable. There is not enough experience accumulated on the use of copper fungi-

cides with the oil, in our case, at any rate, to justify us in making a statement. Dr. Martin is carrying out a lot of work of that sort and has been for a couple of years. He has some forms of copper fungicide that look pretty well. However, during the period of those experiments we have had rather dry seasons. As is well known from our experience with Bordeaux, in a dry season injury from Bordeaux does not make its appearance to any considerable extent. I feel that the data available, so far as we are concerned, is inadequate to base a judgment on the use of a proper fungicide with oil.

MR. S. C. CHANDLER: I think it should be pointed out that in the Middle West there is no call from the growers for oil sprays before the first week in July. Apparently, from what Dr. Headlee says, there is in New Jersey. But in the Middle West, using it from the first of July on, there is very little need for fungicide unless it be on certain varieties where bitter rot is a factor. For that reason that problem has not been studied.

PRESIDENT J. S. HOUSER: We will now hear a paper by Mr. S. C. Chandler.

A SEVEN YEAR STUDY OF THE PLUM CURCULIO IN SOUTHERN ILLINOIS

By S. C. CHANDLER, *Illinois State Natural History Survey*[1]

ABSTRACT

Jarrings show occurrence of Plum Curculio (*Conotrachelus nenuphar*) on peach thruout each season. Petal fall and post season sprays are shown to be unnecessary. Important periods for spraying are indicated. Number of broods and effect of weather conditions on abundance are discussed.

The purpose of this study was to follow the occurrence of the Plum Curculio on peach thruout the season for a number of years to learn its seasonal periods of scarcity and abundance in order that proper recommendations for spraying might be given.

LOCATION OF THE WORK. The work was carried on south of Carbondale in southern Illinois at a latitude which is approximately the same as that of Richmond, Virginia. The isothermal line running thru Carbondale passes thru several southern states. It is entirely possible that Curculio occurrence on peach may be similar all along this line. There

[1]Contribution No. 5 of Ill. State Nat. Hist. Survey.

is a considerable difference in peach spray recommendations in these states.

METHOD. In order to determine the natural occurrence of the insect undisturbed by sprays, unsprayed and usually neglected peach orchards

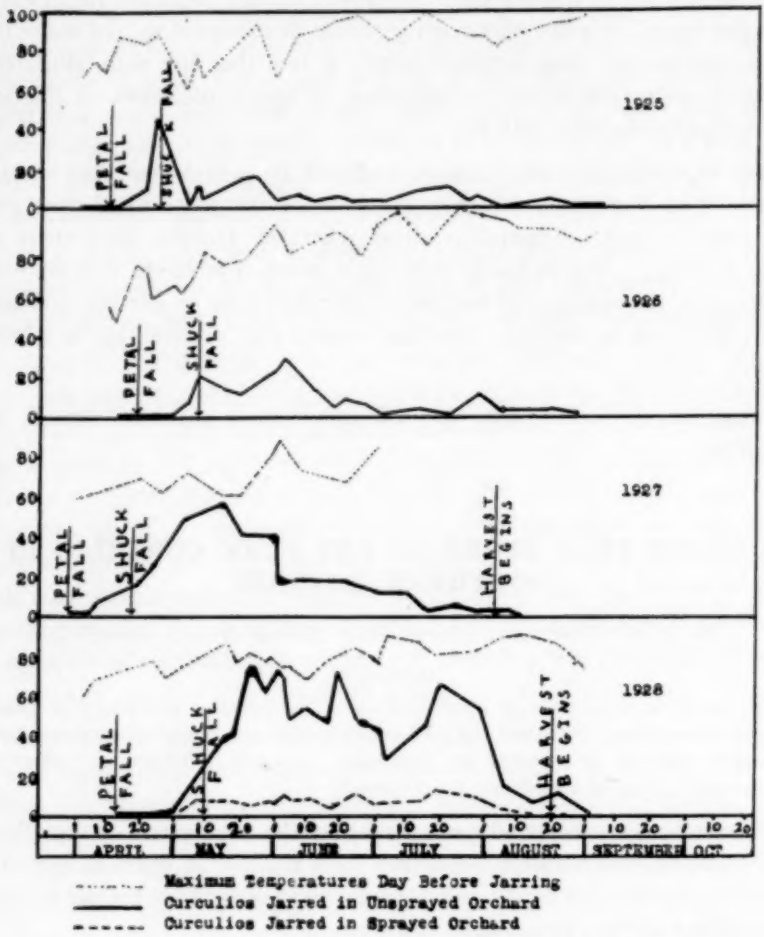


FIG. 3.—Plum curculio occurrence on peach, Carbondale, Illinois.

were selected each year. For three years a comparison was made with commercially sprayed orchards. The occurrence of the beetles was determined by jarring in the morning while they were still inactive, usually between 5 and 6:30 A. M. Ten trees were taken as a unit. Two sheets, 6 ft. by 9 ft., were spread under the tree, one on either side of the trunk.

As a matter of convenience in moving from tree to tree, light strips of wood were tacked on the two long sides of the sheets. A pole with a padded block of wood at the end was used for jarring. Curculios were picked from the sheets, counted and immediately liberated. No jar-

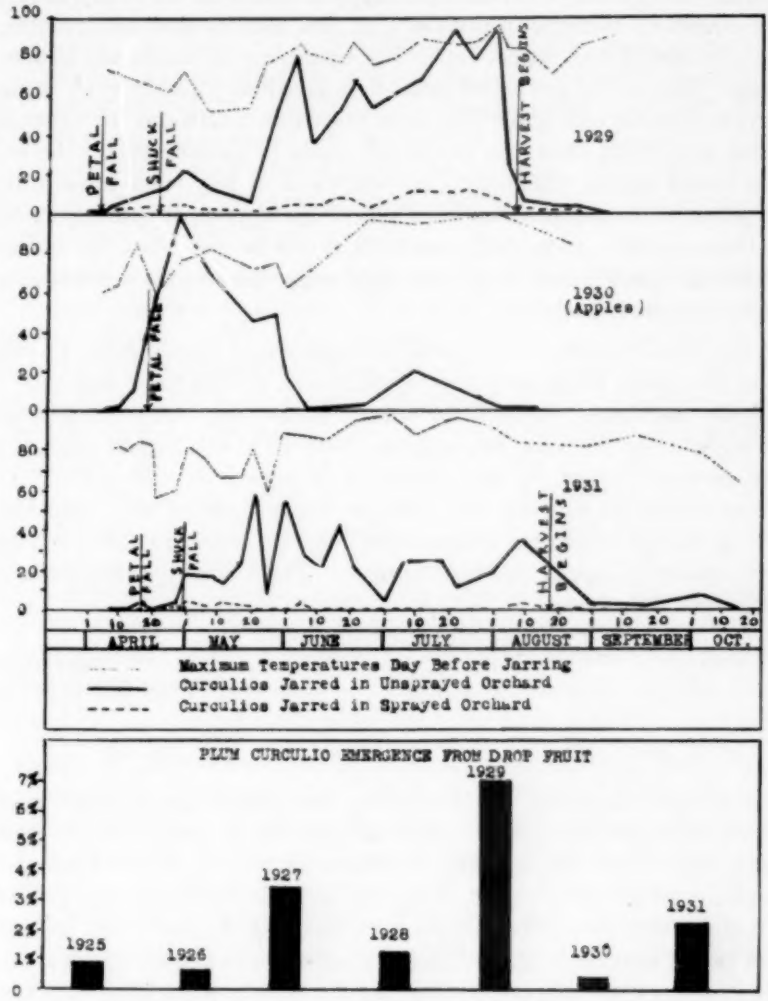


FIG. 4.—Plum curculio on peach, Carbondale, Illinois. (Continued)

rings were recorded following rains the preceding night as rains force the curculios to leave the trees temporarily. In 1930, due to a total failure of the peach crop, records were made in apple orchards. Much of the

data secured is presented in the accompanying graphs, a study of which in the writer's opinion will lead to the following conclusions.

Occurrence on Peach. 1. In general the occurrence on peach is somewhat as follows. Curculios first appear soon after the petals are off. Then occurs an increase in numbers, at first usually slow and reaching a peak in from 3 to 8 weeks depending mainly upon maximum temperatures. The decline from this peak may continue steadily even in unsprayed orchards and under the most favorable conditions for Curculio development until there are practically none in the orchard by the end of the peach season, with only a moderate rise in July when most of the emergence from drop peaches takes place. In seasons of abundant rainfall, however, such as in 1928 and 1929, it will be seen that the decline after the first peak is only temporary, and large numbers occurred the last of June and thruout July.

Petal Fall Sprays. 2. A petal fall spray is of little value. In only two of the seven years were any beetles found at this time, and then in negligible numbers. In 1929 the worst "worm year" only one curculio was jarred from 10 trees as compared with 95 at the highest peak. In most seasons beetles are just beginning to appear at Shuck Fall. On two successive seasons previous to this study orchard tests had been made to see whether any difference in final infestation could be noted where a petal fall spray had been applied. The following table shows no appreciable differences.

Per cent Wormy Peaches

Year	Petal Fall Sprayed Blocks	Petal Fall Spray Omitted
1922	5.7%	7%
1923	3.6%	3.3%
	5.6%	

Necessary Sprays. 3. Following the shuck spray other applications are necessary. Most schedules call for a spray two to three weeks after shuck fall, and the timeliness of this is very evident from the graphs of all seven years. Opinions differ as to the necessity of any further use of poison. This study indicates that in more years than not these two sprays are sufficient, but a glance at the graphs shows clearly that in years like 1928 and 1929 infestations take place after this time. It is also plain that the earlier sprays do not eliminate this later infestation. In fact the later peaks in 1928 and 1929 are shown to occur very much at the same time in both sprayed and unsprayed orchards. An application somewhere from the first to the tenth of June in such seasons is necessary. Most Illinois growers consider these three sprays

as an irreducible minimum. The importance of including a poison in the Month-before-harvest application is very evident in both these years. In Illinois we have been following the practice of issuing special notices regarding the necessity or best dates for applying the last two sprays.

Post Season Sprays. 4. Post season sprays are rarely of any value. In most years there is a gradual dwindling away to nothing at harvest. It is probable that Curculios found in appreciable numbers after Elberta harvest in August are second brood beetles. In 1927 the author reared a few individuals of a second brood which emerged about the middle of August[2]. It would appear that the second brood is of little consequence generally in this section.

Effect of Rainfall. 5. The increase in infestation in periods of abundant rainfall which has been noted by others is apparently due to the fact that it facilitates emergence. Each year from two to four thousand early drop wormy fruits were placed in screen covered cages sunk in the ground under trees in an orchard. The percentage of emergence from these cages was always unaccountably small but the relative percentages for the seven year period are of interest. They are shown in an accompanying figure. Frequent and well distributed rains in 1929 are correlated with a heavy emergence that year and probably account for the late continued infestation. The heavy carry-over resulted in a very severe early curculio attack on apples in 1930 (there being no peaches) but as the heat and drought of that year came on, numbers of curculios as will be seen by the graph, decreased rapidly. The result was that in 1931 we experienced the lightest infestation we have had for years.

Preference for Peach. 6. The preference of the Plum Curculio for peach over apple is brought out in the jarrings of 1931. The peach trees jarred in this test were on both sides of the small block of apple trees jarred the same mornings. Eleven times as many Plum Curculios were jarred from ten peach trees as from ten apple trees, both unsprayed for two successive years. This preference may account for the fact that in southern Illinois where there is a large acreage of both apples and peaches, there is rarely any appreciable curculio injury on apple whereas in western Illinois where there are very few peach orchards Plum Curculio is often of more importance on apple than the Codling Moth.

[2]Recorded in a note in the Journal of Econ. Entomology Vol. 20, No. 5.

Mr. O. I. SNAPP: I would like to know what become of the curculios a month after harvest?

MR. S. C. CHANDLER: The probability is that they go into hibernation although a few may be taken in September, but they are usually very inactive.

PRESIDENT J. S. HOUSER: The next paper is by W. P. Yetter, Jr., and L. F. Steiner.

EFFICIENCY OF BAIT TRAPS FOR THE ORIENTAL FRUIT MOTH[1] AS INDICATED BY THE RELEASE AND CAPTURE OF MARKED ADULTS

By W. P. YETTER, JR., *Associate Entomologist*, and L. F. STEINER, *Assistant Entomologist, Deciduous Fruit Insect Investigations, U. S. Bureau of Entomology*

ABSTRACT

Extensive liberations of marked oriental fruit moths (*Grapholitha molesta*) within and at varying distances from large baited areas at Vincennes, Ind., and at Cornelia, Ga., proved that owing to adult migration the benefits derived from the use of baits were spread over much more than the immediate area baited. At Vincennes flights of from 2,000 to 6,500 feet over baited territory occurred following 12 of the 18 releases made there. At Cornelia flights of more than a mile from unbaited to baited peach orchards were recorded. Twenty-six per cent of 53 moths released in an unbaited orchard one-third mile from the center of a 37-acre trapped block were captured in the latter area. Of releases made within baited orchards recoveries ranging from 16 to 85 per cent were made. Little oviposition occurs within 48 hours after adult emergence. Flights of as much as two-fifths mile from unbaited into baited territory occurred within this time. At Cornelia released moths recovered within two days contained an average of 141 eggs, while those recovered between two and five days after release averaged 126 eggs. Most recoveries were made within five days, some however as late as the fourteenth day. A mixture of baits in an area appeared more efficient than a single bait. All efforts at artificial control of the oriental fruit moth not conducted on a large scale or in isolated orchards will tend to be nullified following emergence of each brood if migration occurs as readily in unbaited as in baited orchards.

The common method of establishing the value of a control measure—that is, by comparing the damage done by the pest in treated with that in untreated areas—will not suffice as a measure of the efficiency of bait traps for the oriental fruit moth. The lack of control obtained, despite large captures of moths, in past experiments where small areas were baited led investigators to assume that the moths migrated into the baited

[1] *Grapholitha molesta* Busck.

areas from the surrounding orchards, stopping occasionally to oviposit before being captured.

This assumption was proved correct in experiments with released marked moths conducted in connection with the large-scale bait-trap investigations at Cornelia, Ga.,[2] in 1930, where oriental fruit moths were found to travel as much as one-half mile to the bait traps. Further experiments of a similar nature at Vincennes, Ind., and Cornelia, Ga., in 1931[3] indicate that the extent of adult movement or migration following emergence has been greatly underestimated.

The most satisfactory means of arriving at some estimate of the effectiveness of bait solutions appears to be the release and recovery of marked adults, supplementing this with examinations of all females for egg content and giving consideration to the age of the females when captured and the distances traveled by the moths before capture.

METHOD OF EXPERIMENTATION. During the 1931 season at Vincennes, Ind., and Cornelia, Ga., more than 3,000 moths were released under a wide variety of conditions. All moths were marked with one of several alcohol-soluble dyes or stains, Eosin, Brilliant Yellow, Bismarck Brown, Spirit Violet, and Spirit Blue being used most frequently. Each release, when made near others within the same 14-day period, was colored differently. All moths used in the experiments were reared in the laboratory and were liberated within 10 or 15 hours after emergence, usually at about 5.00 p. m. and 9.00 a. m. The object was to place them under natural conditions as soon as possible after emergence and with a minimum of handling. When liberated at these times, most of the moths settled immediately into the adjacent trees, and their subsequent movements were entirely natural.

When moths are liberated later in the evening, during the period when they are usually most active, they may be unnaturally stimulated to fly considerable distances before alighting.

Marking was accomplished by placing the moths in a small cylindrical wire-screen cage and spraying them at intervals with the alcoholic dye

[2]W. P. Yetter, jr., and Steiner, L. F. A Preliminary Report on Large Scale Bait Trapping of the Oriental Fruit Moth in Indiana and Georgia. Jour. Econ. Ent. 24:1881–1897. 1931.

[3]The investigations on which this paper are based were conducted at the field laboratories maintained at Vincennes, Ind., and Cornelia, Ga., by the U. S. Bureau of Entomology, under the general supervision of Dr. C. L. Marlatt and in cooperation with the Purdue University Agricultural Experiment Station and the Georgia State Board of Entomology.

solution until a sufficient quantity of the dye had been applied. A small hand atomizer was employed for this purpose and a current of air from an electric fan was utilized to cause rapid evaporation of the alcohol and thus prevent injury to the moths. While the principal object was to color the dorsal surface of the wings, positive identification was easier if some dye was also present on the ventral body and wing surfaces. No apparent injury resulted even when all parts of the body were coated. However, several releases were made at both localities of moths marked with dyes that later were found to injure them or to become unrecognizable. Among these were Spirit Green and Acetin Blue. The results of releases where these dyes were used have not been included.

All liberations, with one exception noted below, were made at some selected locality within peach orchards and only a few feet from a tree. Bait-trap examinations in the vicinity of the release were made every day except Sunday at Vincennes and every one or two days at Cornelia. At Vincennes all oriental fruit moths captured in the traps were brought into the laboratory and examined under the binocular microscope for dye stains and sex. At Cornelia all moths which gave evidence of being marked or about which there was any question were retained for further examination under a binocular microscope. At both localities moths whose colors, under the microscope, appeared questionable were discarded. Female moths were opened and all eggs counted.

Release Experiments at Vincennes, Ind. All releases except one were made within a 180-acre experimental bait area which contained 4,620 traps. The one exception was made in an adjoining alfalfa field. Every other two rows were baited. Usually the outside four were left unbaited. The baits under test in this area consisted of twenty aromatics each used at three different concentrations in two sugar solutions and one molasses solution, four aromatics each used at three different concentrations in one sugar solution, juice made from young terminal peach twigs and leaves in two concentrations in one sugar solution and one molasses solution, together with ten artificial flavors each used at two different concentrations in one sugar solution. All baits were renewed at intervals of three to four weeks. This baited block was not solid, but was broken up into six different orchards which were distributed over an area 1½ miles long and 1 mile wide. Small blocks of unbaited peaches and apples adjoined it on three sides, and several small blocks of unbaited apples were located within the baited peach orchards.

A 26-acre orchard located 1 mile northeast of the 180-acre experimental block was baited with a solution of medium-soft sugar and methyl cinnamate. One-fourth mile beyond this a 100-acre orchard was baited with a molasses-citral mixture. No liberations were made in either orchard. Since only a limited number of traps were examined, any migration into these orchards from the 180-acre block, if it occurred, could not have been observed.

A description of each release follows:

Nos. 1, 2, and 3. Weather generally favorable except for two heavy windstorms during period. Maximum temperature at sunset, 77° F.

No. 4. Weather fair. Maximum temperature at sunset, 86° F. Drought-like conditions existing during June caused large numbers of small insects to come to the traps. They clogged up the traps and in threshing about so beat up the oriental fruit moths that identification of marked individuals was almost impossible.

No. 5. Weather good. Maximum temperature at 7.00 p. m., 92° F. Winds from southwest. Several rains in latter part of period. Most recoveries on second day.

No. 6. Weather good. Maximum temperature at 7.00 p. m., 92° F. Winds from southwest. Moderate rains in latter part of period. Most recoveries made within 24 hours.

No. 7. Weather good. Winds from southwest. Maximum temperature at 7.00 p. m., 92° F. Moderate rains in first part of period. Thirty-six per cent of moths captured within 24 hours.

No. 8. Weather good. Winds from southwest. Maximum temperature at 7.00 p. m., 92° F. Slight precipitation at beginning and end of period. Fifteen per cent of moths recovered within 24 hours.

No. 9. Weather fair. Temperatures normal. Precipitation slight. Winds from southwest. Forty-five per cent of moths recovered within 24 hours.

No. 10. Weather fair, same as for No. 9. Eight per cent of moths recovered within 24 hours, 10 per cent on second day, and 26 per cent on third day.

No. 11. Weather fair. Winds shifting. Maximum temperature at 7.00 p. m., 84° F. Practically no precipitation. Twenty-six per cent of moths recovered on second day after release.

No. 12. Weather fair. Winds shifting. Velocity low. Precipitation slight. Temperatures normal. This release was made in an adjoining alfalfa field 250 yards from the nearest traps.

No. 13. Weather cloudy. Winds shifting. Two good rains fell during period. Maximum temperature at 7.00 p. m., 84° F. Twenty-four per cent of moths recovered on third day after release.

No. 14. Weather fair. Winds shifting. Slight precipitation. Temperatures normal. Twenty-six per cent of moths recovered on second day, 19 per cent on third day, and 22 per cent on fourth day.

No. 15. Weather good. Winds of low velocity from southwest. Frequent light showers. Fifteen per cent of moths recovered on first day and 23 per cent on second day after release.

No. 16. Weather same as for No. 15. Thirty-six per cent of moths recovered first day, 22 per cent on second day after release.

No. 17. Weather same as for No. 15.

No. 18. Weather same as for No. 15.

The results of these release experiments are summarized in Table 1.

TABLE 1. RESULTS OF RELEASES OF MARKED ORIENTAL FRUIT MOTHS AT VINCENNES, IND., IN 1931

Release No.	Date Released	Moths Released	Moths Recovered		Average Egg Content	Longest Flight Distance and Direction	Time Required	Average Distance Traveled	Date of Last Recovery
		Number	Number	Per cent	Number	Feet	Days	Feet	
1	June 2	22	13	59.09	87	1,700–S	2 to 3	730	June 16
2	June 3	11	4	36.36	115	375–SE	1	150	June 5
3	June 5	9	6	66.66	118	825–SW	4 to 5	270	June 11
4	June 30	37	8	21.62	71	200–SW	1	145	July 6
5	July 8	42	18	42.85	30	3,100–SW	12 to 13	530	July 21
6	July 16	67	24	35.82	46	1,925–S	1	480	July 22
7	July 17	99	64	64.65	42	2,150–NW	3 to 4	400	July 22
8	July 20	39	16	41.02	64	5,550–SE	1	1,210	July 26
9	July 21	48	41	85.41	47	4,225–S	1	725	July 27
10	July 22	160	104	65.00	60	3,575–E	5 to 6	315	Aug. 1
11	Aug. 5	102	63	61.76	46	6,525–S	1	535	Aug. 17
12	Aug. 6	91	5	5.49	28	2,300–W	6 to 7	1,360	Aug. 13
13	Aug. 10	110	53	48.18	60	2,300–S	6 to 7	290	Aug. 17
14	Aug. 13	100	76	76.00	55	3,650–S	2 to 3	515	Aug. 20
15	Sept. 14	76	45	59.21	134	4,125–SE	1 to 2	635	Sept. 19
16	Sept. 15	86	54	62.79	143	3,450–SE	1 to 2	460	Sept. 21
17	Sept. 15	28	8	28.57	112	5,075–SE	2 to 3	1,440	Sept. 22
18	Sept. 16	37	7	18.91	106	1,650–E	5 to 6	430	Sept. 22

RELEASE EXPERIMENTS AT CORNELIA, GA. The 42,000-trap block, in which some of the releases were made, included all peach trees in an area approximately 2¼ miles long and 1 mile wide. One trap was placed in each tree. This area extended in a northwest-southeast direction with practically all unbaited orchards either northeast or southwest of it. All traps contained a solution of 10 per cent medium-soft sugar plus emulsified ethyl cinnamate at a concentration of 125 cc. per 100 gallons. This bait was renewed every three or four weeks.

The 37-acre block, in which other releases were made, contained 2,400 traps, every other two rows being baited. More than 100 different bait solutions were under test in this area, and these were also renewed every three or four weeks. The block was surrounded by unbaited peaches and apples and was located three-fourths of a mile northeast from the center and one-fourth mile from the boundary of the 42,000-trap block.

Additional releases were made in outlying orchards one-fourth to one mile from any bait traps. Several were made among 240 traps located

near the center of a 100-acre orchard. Still other releases were made among 20 traps located near the center of two 10-acre tracts. The latter covered only one-third acre. The 240 traps were distributed one trap per tree over 2½ acres.

Releases 19 to 26 were made within the 42,000-trap area, 27 to 32 inside the 37-acre experimental bait area, 33 among 240 traps covering 2½ acres near the center of a 100-acre orchard, and 34 and 35 among 20 traps near the center of two 10-acre tracts. Releases 36 to 40 were made in orchards outside the baited area and from 400 yards to one mile from the nearest traps. Additional notes on each release follow:

Nos. 19 to 21. Made near the center of the 42,000-trap area. Only the traps out to an average distance of 800 feet in all directions from the point of release were examined. The longest flight was made to the end of the orchard. Weather conditions after May 4 were unfavorable, 62° F. being the maximum temperature at sunset during the period. Rainy weather prevented daily examinations of all the traps.

Nos. 22 and 23. Made on the west side of the 42,000-trap area. Traps were examined out to an average distance of 600 feet from the point of release. Weather warm, with seven rainy afternoons or evenings during the period.

Nos. 24 to 26. Made near the southeast end of the 42,000-trap block. Traps in 35 acres surrounding the point of release were examined. The moth which flew 3,300 feet west was accidentally found in a trap far outside the area under examination. One-fifth of the moths recovered were taken along the boundaries of the area, some being more than 1,000 feet from the point of release. Temperatures normal, precipitation negligible, wind velocity low.

No. 27. Made within the 37-acre experimental bait area where the average distance from the center to the outside row of traps in all directions approximates 750 feet. Forty-four per cent were recovered the first day. More than half the total recovery was made by bait solutions three weeks old. Weather conditions were normal.

Nos. 28 to 32. Made within the 37-acre area. Weather was normal except for drought conditions. Winds of low velocity, shifting, but generally from the southwest.

No. 33. Made among 240 traps covering an area of 2½ acres within a large otherwise unbaited orchard. Most recoveries were made by the outer traps, the average distance from center to outside being about 220 feet. Weather conditions were normal except at the time of release, when the wind velocity was high.

Nos. 34 and 35. Made among 20 traps covering about one-third acre near the center of two 10-acre orchards. The average distance to the outside traps was only 60 feet. Weather was normal except for frequent showers.

No. 36. Made in an unbaited peach orchard 400 yards northeast from the nearest corner and three-eighths mile from the center of the 37-acre area. The 26.4 per cent recovery occurred in all parts of the latter area. The first recovery, two-fifths of a mile from the point of release, was made on the second day. Weather was normal with shifting winds of low velocity.

Nos. 37 and 40. Made in an unbaited orchard 1 mile east by southeast of the 37-acre area and 1 mile northeast of the nearest corner of the 42,000-trap block. Both moths after making flights of over 1 mile each were captured in the former area. Weather was normal with shifting winds of low velocity.

Nos. 38 and 39. Made in two young, very rapidly growing orchards one-third mile southwest of the 42,000-trap area. One female was recovered there where trap examinations in connection with releases Nos. 22 and 23 were in progress. Weather was warm but rainy.

The results of these releases are summarized in Table 2.

TABLE 2. RESULTS OF RELEASES OF MARKED ORIENTAL FRUIT MOTHS AT CORNELIA, GA. IN 1931

Release No.	Date Released	Moths Released Number	Moths Recovered Number	Moths Recovered Per cent	Average Egg Content Number	Longest Distance and Direction Feet	Flight Time Required Days	Average Distance Traveled Feet	Date of Last Recovery
19	May 2	42	19	45.24	115	300–W	12 to 14	115	May 16
20	May 3	28	5	17.85	103	225–E	6 to 8	120	May 11
21	May 4	9	3	33.33	undetd.	900–SE	3 to 4	580	May 16
22	July 11	44	19	43.18	86	300–N	6 to 7	75	July 21
23	July 12, 13	99	26	26.26	122	750–N	7 to 9	150	July 21
24	Aug. 30, 31	100	28	28.00	156	3,300–W	2 to 3	495	Sept. 10
25	Sept. 1	94	20	21.27	165	1,200–N	2 to 3	335	Sept. 12
26	Sept. 2	103	33	32.03	128	900–E	2 to 3	290	Sept. 14
27	July 7	50	42	84.00	138	600–SW	1	215	July 16
28	Aug. 26	60	10	16.66	138	1,000–E	2 to 3	530	Sept. 1
29	Aug. 31	80	24	30.00	137	1,200–E	1 to 2	350	Sept. 12
30	Sept. 3	120	55	45.83	126	900–W	1 to 2	420	Sept. 14
31	Sept. 9	27	19	70.37	93	750–N	1 to 2	360	Sept. 14
32	Sept. 10	23	12	52.17	117	1,000–E	1	425	Sept. 19
33	July 9	140	54	38.57	117	300–NW	4 to 5	200	July 21
34	June 29	79	16	20.25	132	70–S	1	50	July 2
35	June 30	83	4	4.82	121	60–S	1	50	July 2
36	July 7	53	14	26.41	83	2,600–SW	3 to 4	2,000	July 18
37	July 7	80	1	1.25	(Male)	6,000–NW	4 to 6	6,000	July 13
38, 39	July 11, 12	81	1	1.23	130	1,750–NE	1 to 2	1,750	July 14
40	Aug. 27–29	204	1	0.49	133	6,100–NW	3 to 5	6,100	Sept. 1

MIGRATION OF THE ORIENTAL FRUIT MOTH. The oriental fruit moth seldom oviposits within 48 hours after emergence. This permits considerable migration before egg deposition begins. At Vincennes marked moths recovered and dissected within 48 hours after emergence averaged 73 eggs, those between 2 and 5 days old averaged 62 eggs, those 5 to 8 days averaged 51, and those more than 8 days old contained 22.

The number of eggs of those more than 8 days old varied from 0 to 103, and those of less than 2 days from 7 to 256. All the captured marked moths were taken from the traps and transferred to small vials containing a little water. Most of the moths were alive when the traps were examined. Owing to the shaking received in the vials while they were being taken to the laboratory and the delay preceding the examination, practically all the moths had been dead from 2 to 4 hours before they could be examined. This condition might have made it impossible to account for all the eggs the moths may have contained prior to death.

At Cornelia egg counts were made only in moths alive immediately before dissection. Marked moths recovered and dissected within 48 hours after emergence averaged 141 eggs, those between 2 and 5 days averaged 126, those 5 to 8 days averaged 97, and those more than 8 days averaged 89. The egg content of the latter varied from 28 to 171, and for those less than 2 days 85 to 231. Most recoveries at both localities were made within 5 days. The egg content of the moths recovered from releases 27 and 36 at Cornelia offer an interesting comparison and indicate that moths coming from outside the baited area deposited many of their eggs before they were captured. That some of this deposition occurred within the 37-acre area is probable, since the captures were made in all parts of it.

Rainfall, wind velocity, and temperature during the hours of greatest moth activity directly affect the catch of moths and apparently likewise affect egg deposition. Wind direction appears to have slight effect on direction of flight, although the long flights were most frequently made against winds of low velocity or in calm weather. High winds may carry the moths, but they normally tend to reduce adult movement. At Vincennes the most striking migrations occurred before peach harvest, with the females traveling farther than the males. The average distance traveled by the females from the point of release was 525 feet and by the males, 465 feet. The maximum airline distance traveled by a female was 6,525 feet and by a male, 4,225 feet. These flights were made from one baited orchard to another. At Cornelia, although extensive flights were made before peach harvest (see releases Nos. 36 and 37), the moths seemed to migrate more extensively after peaches had been harvested and twig growth had ceased, when flights of 6,100 feet over unbaited and 3,300 feet over baited territory were recorded.

Aside from release work additional proof of adult movement is available. The 26-acre area at Vincennes baited with methyl cinnamate and brown sugar captured more than eight times as many moths per trap

as the 100-acre citral-molasses block which was located one-quarter mile away. Bait-trap records in the former area indicate that approximately 20,000 moths were trapped and the internal examination of 36,070 fruits shows that about one-half of 1 per cent of the fruit was infested. There is little doubt that this block attracted moths from the surrouding territory, possibly from the citral-molasses block where approximately 8,000 moths were trapped and where internal examinations of 86,647 fruits showed an average infestation of 2.3 per cent. In the check orchards the average infestation of the fruit was 4.87 per cent. At Cornelia the 37-acre experimental bait area captured four times as many moths per trap as the 42,000-trap block, although the worm population within it for the season was, with one exception in the larger area, lower than in any orchard within six miles of it. Twig injury was almost impossible to find while fruit-infestation records based on internal examinations of 8,300 fruits indicated that entrances of the oriental fruit moth in fruit would not average more than 3.7 per tree, or 18,000 for the 37-acre area. Yet 18,500 moths were captured within it. Worm entrances in fruit averaged 25 per tree in the 19 unbaited orchards used as checks.

The percentages of recovery obtained in the 37-acre block at Cornelia, where a mixture of bait solutions as being tested were higher than in the large area where one standard bait was used, More extensive movement in the large area may partly account for this. However, 100 traps of the standard bait used in the 37-acre area as a check captured 46 per cent more moths per trap than the average of the other 112 baits being tested there. There is reason to assume that a mixture of baits is more efficient than a single bait. At both localities fermenting baits renewed completely every three or four weeks have proved most attractive. By inverting 4-inch shell vials in traps of each bait at Cornelia and measuring the gas accumulation at each examination, a fairly close record of the action of each bait could be kept. Fermentation and likewise attractiveness developed quickly in some and was delayed in others. As the baits were thoroughly mixed, every tree in the orchard continuously had in its vicinity baits in all stages of attractiveness.

CONCLUSION. Comparatively little is known of the chemistry of baits. The opportunities for increasing their efficiency should be great. Although the baits in use have at times captured as high as 85 per cent of the fruit-moth population, the average recovery is much less. Their efficiency, however, is actually greater than the percentage recovered indicates, since many marked moths unquestionably flew out of the area where the traps were being examined before attaining the condition where they

reacted, positively to the bait, some were discarded because of questionable markings, and many were doubtless killed by natural enemies and weather conditions. When releases were made among a small number of traps, very poor recoveries were had and most of the moths recaptured were in outside traps. Fruit injury occurs largely as a result of third and fourth brood larval attack. Theoretically, a bait that could consistently reduce egg deposition 50 per cent would, through diminishing each successive brood by half, effect a reduction of 87 per cent in third-brood larvae and 93 per cent in fourth-brood.

The ability of the oriental fruit moth to fly long distances will prevent the use of bait traps as a control in any but large or isolated peach orchards, or except by several growers on a cooperative basis, unless a bait can be developed which is attractive enough to prevent all oviposition in its vicinity. If the baits at Cornelia attracted moths a mile in other directions as they did from the east, the 42,000-trap experiment affected the fruit-moth population over an area of at least ten square miles.

Baits in use at present can not successfully compete against the odors emanating from the peach foliage and fruit. To be most attractive they must be placed in or very near the tree. Away from it they capture practically nothing, Since the natural odors are so much more powerful than the baits, it is not unreasonable to suppose, in the absence of the latter, that migration of the moths to more attractive peach or apple trees takes place as readily and over as great distances as in baited areas. If so, the tendency following the emergence of each brood will be to nullify any other artificial control efforts not conducted on a large scale or in isolated orchards.

MR. W. P. FLINT: I would like to ask Doctor Steiner if he has at the present time any bait which he feels is effective enough to recommend to growers to use?

MR. L. F. STEINER: We have not. We have tested a hundred or more different baits but we find that a mixture of baits is more attractive than any single one.

MR. S. C. CHANDLER: I would like to ask how large an area has to be baited in order to be of any value?

MR. L. F. STEINER: It depends somewhat on the infestation. We have secured a 90 per cent reduction on a 37-acre block as compared

with a surrounding unbaited tract. In larger areas the reduction runs about 75 per cent after two years' baiting.

PRESIDENT J. S. HOUSER: We will now listen to a paper by Mr. Ray Hutson.

THE CONTROL OF CHERRY CASE BEARER (*COLEOPHORA PRUNIELLA*) BY DORMANT AND OTHER SPRAYS[1]

By RAY HUTSON, *Department of Entomology, Michigan State College*

ABSTRACT

Cherry case-bearer, *Coleophora pruniella*, is susceptible to control by dormant applications of rather high concentrations of oil emulsions, miscible oils, and tar washes. Nicotine and derrisol combined with lime-sulphur 1–40 can be used effectively if properly timed.

Cherry case-bearer (*Coleophora pruniella*) is at present a pest of cherry in portions of Michigan (5)[2], of cherry and apple in Wisconsin (4) and of apple in Quebec (7). The case-bearing larvae inflict damage to the foliage of affected trees at two distinct periods:—just as the buds are bursting, and during August and September just after the eggs hatch. The fruit likewise is sometimes attacked. The young larvae move from leaves to twigs and small branches during late September, where they secure their cases tightly with spun silk and secretions, remaining until the buds burst in the spring.

METHODS. All experiments detailed in this paper were conducted in the same orchard unless otherwise indicated. The regular orchard spraying equipment, operated by the owner, was employed without modification of his routine. It was, however, suggested that thorough coverage of the smaller branches and twigs was desirable.

The materials employed in the sprays are all well-known, and it is unnecessary to further discuss them except to define clearly the nature of the home-made emulsion used. This was manufactured in the spray tank, using the Kayso formula given in the 1931 Michigan Spraying Calendar (2). It should be made clear that the percentage compositions of home-made emulsions in Table 2 refer to the actual oil content.

All tabulated results were obtained by counting the case-bearers on three branches from each of 10 count-trees, averaging the results for each tree, and then summating these averages for the plot. The branches showed an average of 6 linear feet of growth each and were selected,

[1]Authorized as Journal Article No. 89 (n. s.) from the Mich. Agr. Exp. Sta.

[2]Figures in parentheses refer to citations.

one each, from the top, the windward, and the leeward sides of the trees. This method, though laborious, has the advantage of making the results of dormant applications comparable with those obtained when nicotine, derrisol, etc., were applied just after the case-bearers were nicely established on the young leaves.

EXPERIMENTAL WORK. Previous experimental work on this (4, 7) and a related species (6) suggested three methods of attack: stomach poisons, summer applications, and dormant applications of contact sprays. While the experiments were undertaken at three distinct times in two growing seasons, all were conducted on the same brood of larvae and can be most logically presented under two sub-heads; tests with stomach-poisons, and tests with contact sprays.

TESTS WITH STOMACH POISONS. Previous workers (4, 7) have reported the inadequacy of stomach-poisons when used against the cherry case-bearer, but since it is not apparent from the published records that tests of these materials against young larvae were included and it is well known that many insects are killed more readily by stomach-poisons in their earlier instars, a trial of arsenate of lead was projected. The value of exact knowledge as to whether this universally available insecticide could be used is apparent for two reasons, other than those commonly associated with this poison. The early instars of the cherry case-bearer occur after the fruit is picked, when there is not any danger from residue. Arsenate of lead, being compatible with lime-sulphur, can be combined with the routine fungicidal sprays necessary for control of leaf-spot.

As a result of these definite conditions a series of plots was laid out and sprayed with arsenate of lead, 3 pounds to one hundred gallons of lime-sulphur 1–40, the usual leaf-spot spray (2). In order to establish the proper timing, should lead arsenate prove of value, three applications were made at intervals of one week. The dates of application coincided with the beginning (Aug. 11), peak (Aug. 18), and completion (Aug. 25) of hatching. After the surviving case-bearers had migrated to their winter homes on the smaller branches and twigs, counts were taken on the different sprayed plots and upon the check. Table 1 is a resumé of these counts which is presented to complete the record on the use of arsenate of lead against cherry case-bearer.

TABLE 1. COMPARATIVE NUMBERS OF OVER-WINTERING CASE-BEARERS ON PLOTS SPRAYED WITH LEAD ARSENATE

Date Applied	Case-bearers
8/11/30	282
8/18/30	348
8/25/30	471
Check	411

It will be apparent from an examination of Table 1 that three pounds of lead-arsenate in lime-sulphur 1/40, at the time of and immediately after, hatching did not reduce the number of cherry case-bearers migrating to winter quarters to a sufficient degree to constitute by itself a satisfactory control. The data do indicate, however, that the inclusion of 3 pounds of arsenate of lead in an after-harvest fungicidal spray, applied just as the eggs are hatching, gives a measurable decrease in the number of case-bearers reaching winter quarters.

TESTS WITH CONTACT SPRAYS. Contact sprays have been used with success against pistol case-bearer (6) and against cherry case-bearer (3, 4). Further investigation of their possibilities was undertaken with the idea of perhaps finding new materials, methods, times of application, or combinations of these factors which would reduce the cost of control and provide a greater margin of safety to the cherry tree than had been previously demonstrated (3, 4).

The tests made with contact sprays were carried on at three different periods, August 1930, April 1931, and late May 1931.

Dormant Sprays. The contact sprays tested in April 1931, consisted of the more promising, selected from several series tried out in the laboratory during the winter. These sprays were all suited to dormant application and in addition to the observations on toxicity to overwintering case-bearers, a close watch was kept on the sprayed trees for oil injury (4). Data collected in this series of tests are embodied in Table 2.

TABLE 2. CONTROL OF CASE-BEARER BY DORMANT SPRAYS

	% Concentration	No. Case-bearers Alive	No. Case-bearers Dead	$\frac{x-y}{x} \times 100 =$ % control (1)
Barko	10	15	674	98
Barko	6.66	25	496	95
Barko	5.0	40	510	93
Tar wash	6.66	74	510	86
Home-made emulsion	6	45	699	93
Home-made emulsion	4*	388	578	57
Home-made emulsion	3*	437	372	42
Emulso	8	69	797	92
Dendrol	8	79	690	89
Kleenup	8	34	770	94
Check	0	512	33	6

*Plus .5% crescylic acid.

Examination of Table 2 reveals that a satisfactory kill of case-bearer larvae was had by dormant applications of the higher percentages of materials tried. It should be apparent also that lowering the concen-

tration gave a reduced kill. No injury to the trees is noted in the table for none was observable. This last fact is not in consonance with the results of other workers (4), and indicates only that more information concerning tolerance of cherry to high oil concentrations is desirable.

Summer Applications:—Tests with contact sprays other than the dormant period, for convenience labeled summer applications, were conducted in August 1930 and during May 1931. The tests made in1930 were conducted in an orchard (5) near, but not upon, the same farm as those in 1931 and, since the results are not considered significant enough for tabulation, a mere mention of materials, conditions and results will suffice.

TABLE 3. CONTROL OF CHERRY CASE-BEARER BY SUMMER APPLICATIONS OF CONTACT SPRAYS

Material	Concentration	No. Case-bearers Alive	Dead	$\frac{x-y}{x} = \%$ control (1)
Nicotine sulphate with lime-sulphur	1–800 1–40	58	436	88
Nicotine sulphate with lime-sulphur	1–400 1–40	44	591	90
Derrisol with lime-sulphur	1–800 1–40	71	473	84

The trials carried out in 1930 consisted of applications of nicotine, 1 pint in 100 gallons of 1–40 lime sulphur; nicotine, 1 pint plus penetrol ½ gallon in 100 gallons of spray; and verdol 2%. All of these materials were applied on August 11th in the middle of the day with the temperature ranging 75°–82° F. during the spraying. It is well to recall also that the larvae were just beginning to hatch on this date. Counts four days later revealed less than 50% control on any plot.

In early May, 1931, observations on case-bearer larvae which migrated to the leaves and buds revealed an interesting fact: The valve in the distal end of the case is commonly kept open while the larvae inside are feeding. This opening is apparently utilized by the insect in ejecting excrement from its quarters.

Since the opening seemed to furnish an avenue for the penetration of insecticides, plots were laid out and applications of various combinations of insecticides applied. These were applied May 13, 1931, while the temperature ranged between 60°–70° F. The counts were made as described under methods on June 3. The materials used and the control attained appear as Table 3.

A perusal of Table 3 shows that properly timed contact sprays of

nicotine and Derrisol show decided promise of case-bearer control. It is apparent, of course, that the contact materials tested were in the regular lime-sulphur sprays going on at that time. The value of these data is at present that of indicating a comparatively effective emergency spray in case a dormant spray is not applied.

SUMMARY. The data presented show control of case-bearer by dormant applications of oils and tar washes without injury to the trees. Nicotine and derrisol show promise against the active larvae. The absence of injury in plots sprayed with dormant oils and dormant oils and tar washes is not stressed.

Certain facts are noted in the habits of case-bearer and their significance in timing spray applications noted.

ACKNOWLEDGMENTS. The progress of these experiments was greatly aided by valuable counsel from R. H. Pettit, assistance in making counts by M. G. Farleman, and the cooperation of Roy Holmes, Old Mission, Michigan, fruit grower.

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Adjournment 11:55 a. m.

A REPLY TO BURRILL AND PARRIS ON THE USE OF CALCIUM CYANIDE RAW LINSEED OIL MIXTURE FOR THE CONTROL OF THE ROUND HEADED APPLE TREE BORER

By C. E. PETCH, *Hemmingford, Que.*

ABSTRACT

This is a defence of the calcium cyanide raw linseed oil mixture for use against the round headed apple tree borer. Extracts have been selected from the paper by Burrill and Parris to show that their criticisms were unjust, since they admit its safeness when used according to directions. When injury occurred, methods were adopted by them which were neither advised nor implied. The mixture has been used successfully for several years and it is still being recommended.

The trees, which were injured by this mixture, were examined by me shortly after the injury took place. It was self-evident that there had been a gross error in application. This is admitted by Burrill and Parris[1] when they state, "The extremely serious injury occurred where the mixture was applied as a complete collar for a distance of 12 to 15 inches from the crown of the tree upward." The recommendation consists of applying a paste composed of calcium cyanide and raw linseed oil to the parts of the tree where the castings are observed.[2] The mistake made by Burrill and Parris consisted of gassing the trees instead of the borers. This was entirely an error of application and is no more a just criticism than if one used twenty pounds of calcium arsenate when one pound was recommended. It would certainly not be any proof that calcium arsenate was not a safe insecticide when used as recommended.

In this particular case the growers were trying to use the material to prevent oviposition and if eggs were laid on the trunk then they hoped the eggs would be injured or the young larvae killed. .Nothing in my circular suggested the mixture could be used for such purposes.

Burrill and Parris state on page 712, "The cases of most serious injury were ones in which prior to the application of the calcium cyanide-oil mixture the grower had cut out with his knife such borers as he could easily reach." They neglect, however, to point out that in no part of my circular is it recommended to cut away the bark before applying the mixture. Naturally, if this had been essential to ensure success it would

[1]Burrill and Parris.—Injury to apple trees from the use of calcium cyanide raw linseed oil mixture in controlling the round-headed apple tree borer. Jour. Econ. Ent. June, 1931.

[2]Petch, C. E.—The round-headed apple tree borer and its control. Dept. of Agric., Canada. Entom. Br. Circ. No. 73. 1930.

have been mentioned. It is generally accepted that if success is to be attained then the correct procedure is to follow the directions.

The authors admit several times in their article that when the bark was not disturbed no injury resulted. For example, "Whatever significance these factors may have had, the striking correlation between the severity of injury and exposure of cambium by cutting bark with a knife prior to applying the mixture, suggested this exposure as the factor chiefly responsible."....."In two check branches receiving the same treatment except that the bark was left intact, no injury resulted." ....."The second experiment included 2 check branches with bark intact, treated with each mixture; none of the mixtures produced any injury when applied to intact bark."

Furthermore, among the trees under discussion many would have died even if they had not been treated, since they were riddled by borers and several of them broke off near the ground when they were bent over. In my circular there is no claim that the mixture would perform miracles and produce healthy trees on dead stumps.

In our experiments calcium cyanide in the form of Cyanogas and Calcyanide has been used on thousands of trees without producing the type of injury cited by Burrill and Parris or killing any trees. Furthermore, many of the trees have been treated on three different occasions. It is admitted by Burrill and Parris that the mixture gave success without injury during 1928 and 1929. Moreover, some growers in the Champlain Valley have advised me that they have used the mixture for several years without any apparent injury and even in 1930 when Burrill and Parris ran into difficulties. In addition, reports have been received from California for the past three years to the effect that the mixture has been used on several kinds of trees without injury and similar results could be obtained from Quebec apple growers who have used it.

Mention is made in the article of local injury to the cambium but even when no mixtures are applied the cambium near the wound is not very healthy. This is probably the reason for trees affected with several borers dying even when narrow strips of bark remain between the tunnels.

From the admissions of error in application by Burrill and Parris and in consideration of the evidence submitted in this reply, it may be reasonably concluded that had the directions been followed the injury would not have occurred. We are continuing to recommend this method of borer control believing it to be a safe and satisfactory practice.

INSECTICIDAL ACTIVITY OF ALIPHATIC THIOCYANATES. I. APHIS

By D. F. MURPHY and C. H. PEET, *Research Laboratories, The Röhm and Haas Company, Inc., Bristol, Pennsylvania*

ABSTRACT

Certain aliphatic thiocyanates have shown high insecticidal value against a variety of insects. This paper reports the results of extended tests upon *Aphis rumicis L.*

Synthetic dyes and synthetic drugs have largely displaced the natural products which have formerly been used. This has come about in large measure because the synthetic compound can be produced when needed and in as large quantities as needed without dependence upon seasons or weather and, which is of even greater importance, because the quality and uniformity of the synthetic can be controlled with an accuracy which is impossible in the case of natural products. The economic advantage of synthetic over natural materials has been too often demonstrated and is too obvious to require further elaboration.

In the case of dyes, drugs, perfumes and other synthetics, definite relationships have been established between structure and effect and these relationships have afforded bases for the development of new compounds possessing particular advantages for the purpose for which they are designed. In the field of insecticides, however, no such relation between chemical structure and insecticidal action has previously been established. Minor alterations in the nicotine molecule result in compounds which are practically without insecticidal value.[1]

Staudinger[2] reports the inactivation of the pyrethrins when the pyrethrolon half of the esters is replaced by other alcohols or when the chrysanthemum acids are substituted by other acids. Similar results have been observed with other insecticides.

Extended research upon synthetic organic insecticides in these laboratories has disclosed that the insecticidal activity of certain groups persists in spite of important changes in the molecule to which these groups are attached. Most effective of the groups thus far brought to light is the thiocyanate group,[3] $-S-C\equiv N$.

Alterations of the organic residue attached to this group produce definite changes in insecticidal activity but all such changes are in degree

[1] La Forge, J. A. C. S., 50, 2471–2487 (1928).
[2] Staudinger and Ruzicka, Helv. Chim. Acta 7, 177–259; 377–457 (1924).
[3] U. S. Patent 1,808,893.

TABLE 1. TESTS ON *Aphis rumicis* USING A SPRAY CONTAINING 0.0625 PER CENT ALIPHATIC THIOCYANATE AND 0.25% POTASSIUM STEARATE

Test No.	No. of Aphis	No. Dead	Per cent Dead
1	57	53	93
2	92	87	95
3	34	34	100
4	45	44	98
5	88	88	100
6	62	62	100
7	57	56	98
8	103	102	99
9	97	96	99
10	63	60	95
11	92	92	100
12	99	95	96
13	78	76	98
14	104	102	98
15	115	115	100
16	94	94	100
17	76	75	99
18	89	87	98
19	35	35	100
20	29	28	97
21	107	107	100
22	33	33	100
23	83	82	99
24	93	92	99
25	113	113	100
26	76	75	99
27	99	98	99
28	165	165	100
29	44	44	100
30	104	104	100
31	94	91	97
32	32	32	100
33	44	44	100
34	49	48	98
35	98	94	96
36	112	108	96
37	41	41	100
38	89	85	96
39	77	76	99
40	68	67	99
41	83	83	100
42	56	55	98
43	89	88	99
44	40	40	100
45	43	42	98
46	33	33	100
47	47	46	98
48	33	32	97
49	45	45	100
50	52	51	98
Total	3651	3595	
Average	73	71.9	98.58

	Check—0.25% Potassium Stearate only	
	No. of Insects	No. Dead
	24	5
	31	4
	55	6
	68	3
	44	2
	23	3
	93	10
	19	1
	39	9
	27	4
Total	403	47
Average	40.3	4.7

% Dead
21
13
11
4
5
13
11
5
23
15
12.1

rather than in kind. This, of course, permits of modification to develop insecticides possessing special properties for special purposes.

This paper will not go into the effects of changes in molecular constitution but will report only the laboratory results obtained in the application of one organic thiocyanate to certain agricultural pests. The aliphatic thiocyanate with which this paper deals has been applied extensively in field tests and excellent results have been obtained but only the laboratory tests which were preliminary to field application will be reported at this time since the percentage kill is more easily and accurately determined in the laboratory than in the field.

TABLE 2. CHECK TEST ON *Aphis rumicis* USING A .225% SOLUTION OF POTASSIUM OLEATE

Test No.	No. Aphis	No. Dead	Per cent Dead
1	180	19	10
2	123	9	7
3	94	6	6
4	136	7	5
5	97	8	8
6	71	6	8
7	88	5	6
8	119	10	8
9	94	8	8
10	96	9	9
Total	1105	87	
Average	110.5	8.7	7.5

Accurate counts of dead and living were run on a variety of insects including such resistant pests as mealy bug (*Pseudococcus citri* Risso), greenhouse orthezia (*Orthezia insignis* Dougl.) and greenhouse red spider (*Tetranychus bimaculatus* L.) but this paper will deal only with tests on the more commonly employed test insect, *Aphis rumicis* L., and later papers will report tests on the other insects tested.

In these tests the spray was applied with a small Lowell hand sprayer and enough spray was used to wet both plants and insects well. Field tests demonstrated that more adequate spraying equipment gave still better results. In all cases, only a single application of the insecticide was made in order that the direct and immediate effect might be determined and the counts of dead and living insects were made 24 hours after spraying.

In the aphis tests each infested plant was cut off above the soil line, the stem was thrust through a drilled cork stopper and the stopper was then put in place in a small bottle of water. After being sprayed, each bottled shoot was placed in the center of a small plate, the rim of which

had been coated with Tree Tanglefoot. When the final counts were made, all insects caught in the Tanglefoot were counted as alive.[4]

The plants used in these tests were nasturtium, buckwheat, and others.

An additional control series was run using a 0.225% Potassium Oleate spray with the results shown in Table 2.

The activating action of Penetrol made it seem desirable to parallel the tests reported in Table 1 with a similar series in which Penetrol was used as a spreading and wetting agent instead of soap and the following results were obtained:

TABLE 3. TESTS ON *Aphis rumicis* USING A 0.0625% SOLUTION OF ALIPHATIC THIOCYANATE AND ½% PENETROL

Test No.	No. of Aphis	No. Dead	Per cent Dead	Check—½% Penetrol only		
				No. of Aphis	No. Dead	% Dead
1	27	27	100	41	13	32
2	129	122	95	74	22	30
3	53	51	96	66	18	27
4	22	22	100	49	12	24
5	49	48	98	28	9	32
6	114	114	100	37	11	30
7	98	97	99	98	23	24
8	103	98	95	41	8	20
9	39	39	100	118	27	23
10	75	74	99	26	5	19
11	34	34	100	64	11	17
12	26	26	100	107	9	8
13	46	46	100	23	3	13
14	118	115	98	29	5	17
15	153	145	95	38	9	24
16	97	97	100			
17	124	122	98	Total 851	185	
18	89	88	99	Average 56.1	12.3	22.6
19	114	113	99			
20	59	59	100			
21	63	63	100			
22	48	48	100			
23	77	77	100			
24	64	64	100			
25	109	109	100			
26	87	86	99			
27	63	63	100			
28	37	37	100			
29	28	28	100			
30	99	95	96			
31	132	132	100			
32	32	32	100			
33	26	26	100			
34	84	83	99			
35	33	33	100			

[4]Richardson, U. S. D. A. Bull. 1160 (1923).

TABLE 3. *Continued*

Test No.	No. of Aphis	No. Dead	Per cent Dead	Check—½% Penetrol only No. of Aphis	No. Dead	% Dead
36	53	51	96			
37	37	37	100			
38	29	29	100			
39	47	47	100			
40	61	61	100			
Total	2778	2738				
Average	69.4	68.4	99.0			

As a further check on the testing method employed, tests were made on a well-known pyrethrum insecticide employing the recommended dilution (1:800) and on 40% nicotine at 1:1000 with the following results:

TABLE 4. TESTS ON *Aphis rumicis* USING A COMMERCIAL PYRETHRUM SPRAY DILUTED 1:800 AS RECOMMENDED ON ITS LABEL

Test No.	No. Aphis	No. Dead	Per cent Dead
1	68	63	93
2	54	52	96
3	63	61	97
4	80	78	98
5	38	36	95
6	77	74	96
7	80	77	96
8	61	58	95
9	41	38	93
10	93	90	97
11	31	31	100
12	67	67	100
13	61	59	97
14	79	76	96
15	42	40	95
16	53	49	92
17	54	49	91
18	48	46	96
19	48	45	94
20	53	52	98
21	38	36	95
22	42	41	98
23	23	21	91
24	54	52	96
25	105	101	96
Total.....	1463	1392	
Average.....	58.5	55.7	95.6

TABLE 5. TESTS ON *Aphis rumicis* USING NICOTINE DILUTED 1 VOLUME TO 1,000 VOLUMES OF WATER AND WITH 1% OF LIQUID SOAP ADDED AS RECOMMENDED ON THE LABEL

Test No.	No. Aphis	No. Dead	Per cent Dead
1	93	93	100
2	44	44	100
3	78	76	97
4	84	81	96
5	46	46	100
6	33	33	100
7	106	103	97
8	89	89	100
9	74	74	100
10	22	22	100
11	43	40	93
12	55	54	98
13	84	84	100
14	64	62	97
15	72	71	99
16	46	46	100
17	41	41	100
18	53	51	96
19	59	59	100
20	31	31	100
21	46	43	94
22	64	63	99
23	107	105	98
24	122	122	100
25	84	84	100
Total	1642	1617	
Average	65.7	64.7	98.5

The results given above in full detail have been assembled in the following table for greater ease in comparison:

TABLE 6. SUMMARY OF THE EFFECTIVENESS AGAINST *Aphis rumicis* OF THE INSECTICIDES TESTED TOGETHER WITH THEIR CHECK TESTS

Material Tested	No. of Tests	Conc. of Insecticide	Spreader	% Kill (Average)
Aliphatic Thiocyanate	50	0.0625%	0.25% Potassium Stearate	98.58%
Aliphatic Thiocyanate	40	0.0625%	0.5% Penetrol	99.0%
Nicotine	25	1:1000	0.25% Potassium Stearate	98.5%
Pyrethrum	25	1:800	——	95.7%
		Check Tests		
Potassium Oleate	10	0.225%	——	7.5
Potassium Stearate	10	0.25%	——	12.1
Penetrol	15	0.5%	——	22.6

DISCUSSION. The high degree of effectiveness of certain aliphatic thiocyanates in very low concentrations provides a new and superior weapon for use in insect control. The action of this compound is very rapid and its effectiveness covers a wide range of insects, many of which have stubbornly resisted control hitherto.

The insecticides of this series possess the special merit of marked chemical stability. The concentrated insecticide is not affected by heat, age or those other conditions of storage which result in the deterioration of such insecticides as pyrethrum or derris[5] and material which has been prepared for spraying does not lose its strength on standing.

In addition to chemical stability, the diluted sprays showed no physical alteration on standing several days and they spread and wet especially well.

Finally, the aliphatic thiocyanate upon which the work here reported was done showed no foliage injury upon a wide variety of plants. In many instances, where the plant was in blossom, there was even no injury to the flower.

SUMMARY. A 0.0625% solution of an aliphatic thiocyanate containing 0.25% anhydrous soap killed an average of 98.58% of *Aphis rumicis* L. and the same concentration of the thiocyanate containing 0.5% Penetrol killed 99.0%.

Still more satisfactory results were obtained in practical field tests and these will be reported in a subsequent paper.

Especially good results have been obtained with mealy bug and red spider and these will be reported shortly.

THE TOXICITY OF CERTAIN PLANT EXTRACTS TO GOLDFISH[1]

By NATHAN L. DRAKE and J. R. SPIES

ABSTRACT

The toxicity to goldfish of acetone extracts of certain reputedly poisonous plants has been determined.

Some of these extracts were more toxic than a control extract made from a specimen of derris root known to contain 1.7% rotenone.

The recent interest in certain species of Cracca and Lonchocarpus as possible sources of valuable insecticides has made it seem advisable

[5]Badertscher, J. Ec. Ent. 24, 268–277 (1931). Jones & Haller, J. A. C. S., 53, 2320–2324 (1931).

[1]Contribution from the University of Maryland Station of the Insecticide Division, Bureau of Chemistry and Soils.

From a thesis presented by J. R. Spies to the Graduate School of the University of Maryland in partial fulfillment of the requirements for the degree of Master of Science. The plants used in this investigation were collected under the supervision of Dr. R. C. Roark of the Insecticide Division, and the authors wish to express their thanks to him for the many helpful suggestions which he has made during the progress of the work.

to investigate the toxicity of extracts made from a number of different plants, each of which, like those mentioned above, is known to have some poisonous action on fish or insects. A study of this kind should show which plants have sufficient toxicity to warrant further investigation.

It is the purpose of this paper to record such an investigation in which the goldfish, *Carassius auratus,* was used as the test organism. Although no direct comparison between toxicity of an extract to goldfish and its toxicity to insects is possible, it is comparatively certain that any substance which might be useful as an insecticide will be highly toxic to goldfish. This consideration, together with the fact that tests on fish are far easier to carry out and control than those on insects, led us to adopt fish in these sorting experiments. It is to be understood that any final decision as to the insecticidal value of these substances must rest on tests on insects.

THE PREPARATION OF THE PLANT EXTRACTS. The procedure adopted in preparing the plant extracts was as follows: Thirty grams of the carefully ground plant was extracted in a Soxhlet extractor for seven hours with acetone as a solvent. The extract was diluted to 150 ml. with acetone and portions of this stock solution then added to the test jars at the rate of 1 ml. per liter. Gersdorff[2] has shown that a 1:1000 solution of acetone in water has no apparent effect on goldfish. The fish used weighed approximately 2 grams each and during the tests were confined in three-liter wide-mouth candy jars containing two liters of water and placed in a constant temperature bath at a temperature of 27° C. ± .3°. The fish, two in a jar, were allowed to remain in the constant temperature bath over night before the test was made in order to avoid any ill effects from too rapid a temperature change, and for this reason also, the water with which the candy jars were filled was taken from the aquarium in which the fish were kept.

The time at which two ml. of extract was added to the jar containing the fish was noted, and observations were then made at intervals in order to determine as closely as possible the time of death of the fish, the death point having been shown by Gersdorff[2] to be the most reliable endpoint in the determination of toxicity.

This point was determined by observing the fish closely, and noting when all gill movements had ceased. In order to avoid descrepancies arising from high individual resistance, four fish were used for testing each extract.

[2]W. A. Gersdorff, J. Am. Chem. Soc. 52, 3440 (1930).
[3]loc. cit.

The results of the test are shown in Table 1, which gives also the Insecticide Division reference number (I. D. number) of the plant. Further information concerning the origin and history of the plant materials can be obtained from the Insecticide Division of the Bureau of Chemistry and Soils of the U. S. Department of Agriculture by referring to the I. D. number given. It will be noted that in several cases only the common local name of the plant is given because it was impossible to determine the species from the material at hand.

TABLE 1. TOXICITY OF ACETONE EXTRACTS OF VARIOUS PLANTS TO GOLDFISH
Conc. = 1 ml. of extract (from .2 g. of plant) per liter

Plant	I.D. No.	Part of Plant Tested	Where Collected	When Collected	Av. Time[1] of Death in Minutes
Apurimacia michellii (Rusby) Harms	636	Roots	Lima, Peru	March, 1931	140
Apurimacia michellii (Rusby) Harms	381	Roots	Lima, Peru	Sept., 1930	106
Arrow poison	607	—	Colombia	Jan., 1931	—
Bantano	671	Bark	Ecuador	July, 1929	—
Baptisia tinctoria (L) Br	505	stems + leaves	Biltmore, N. C.	Oct., 1930	—
Baptisia tinctoria (L) Br	505	leaves	Biltmore, N. C.	Oct., 1930	some distress
Baptisia tinctoria (L) Br	505	roots	Biltmore, N. C.	Oct., 1930	some distress
Barbasco	672	roots?	Costa Rica	Oct., 1929	184
Ceratiola ericoides	657	needles	Florida	Oct., 1930	58
Chilillo	642	aerial	Acalpulco, Mex.	March, 1931	serious distress
Chrosperma muscaetoxicum (Walt)	504	roots	Linville, N. C.	Oct., 1930	—
Covillia sp	382	aerial	Texas	1928?	46
Cracca piscatoria	661	aerial?	Hawaii	March, 1930?	179
Cracca purpurea	666	stems	New S. Wales, Australia	March, 1931	slight signs of distress
Cracca purpurea	666	leaves	New S. Wales, Australia	March, 1931	slight signs of distress
Cracca toxicaria	384	aerial	Colombia		142
Cracca virginiana (L) Pers	662(b)	stems	Dunn Loring, Va.	July, 1930	—
Cracca virginiana (L) Pers	662(a)	leaves	Dunn Loring, Va.	July, 1930	207
Cracca virginiana (L) Pers	515	aerial	Biltmore, N. C.	Oct., 1930	208
Cracca virginiana (L) Pers	515	roots	Biltmore, N. C.	Oct., 1930	166
Cracca vogelii	520	aerial	Tanganyika, Terr., Africa	Jan., 1930	106
Cracca vogelii	518	seed pods			161
Cytisus scoparius (L) Link	506(a)	aerial	Biltmore, N. C.	Oct., 1930	—

[1]A dash indicates that the fish were unaffected in 7 hours. In cases where death did not occur in a shorter period, the condition of the fish is described at the end of the 7 hour period.

TABLE 1. *Continued*

Plant	I.D. No.	Part of Plant Tested	Where Collected	When Collected	Av. time of death in Minutes
Cytisus scoparius (L) Link	506(b)	roots	Biltmore, N. C.	Oct., 1930	—
Espave	385	bark or wood	Panama		—
Euonymus americanus L.	507(a)	aerial	Biltmore, N. C.	Oct., 1930	327
Euonymus americanus L.	507(b)	roots	Biltmore, N. C.	Oct., 1930	—
Eupatorium ageratoides L.f.	508(a)	aerial	Biltmore, N. C.	Oct., 1930	—
E. ageratoides L.f.	508(b)	roots	Biltmore, N. C.	Oct., 1930	195
Folha tingui	386	aerial			72
Gleditsia triacanthos L.	521	seed pods	Alexandria, Va.	Jan., 1931	—
Gymnocladus dioica (L) Koch	647	leaves	Washington, D. C.	July, 1930	—
Gymnocladus dioica (L) Koch	648	stems	Washington, D. C.	July, 1930	—
Gymnocladus dioica (L) Koch	649	roots	Washington, D. C.	July, 1930	—
Haplophyton cimicidum A.DC	387	aerial	Mexico	Jan., 1930	—
Ichthyomethia piscipula (L) Hitch	388	roots	Miami, Fla.	April, 1930	94
" "		bark	Miami, Fla.	April, 1930	—
" "		wood	Miami, Fla.	April, 1930	248
Jacquinia caracasana	389	leaves	Caracas, Venezuela	Jan., 1930	—
Manzanillo Comun	390	Bark + Burr	Panama		42
Manzanillo pulludo	391	Bark	Panama		—
Melia azedarach	509(a)	aerial	Spartanburg, S. C.	Oct., 1930	some distress
Melia azedarach	509(b)	roots	Spartanburg, S. C.	Oct., 1930	336
Mochangoko	392	bark	East Africa	1929	104
Nupa (Palma de Coco)	658	aerial	Panama		2 fish dead 2 in great distress
Parosela barbata (Oerst) Rydb	383	aerial	Caracas, Venezuela	March, 1930	223
Phytolacca decandra L.	510	roots	Biltmore, N. C.	Oct., 1930	—
Robinia boyntonii	511(a)	aerial	Hendersonville, N. C.	Oct., 1930	—
Robinia boyntonii	511(b)	roots	Hendersonville, N. C.	Oct., 1930	—
Robinia pseudacacia	512(a)	aerial	Biltmore, N. C.	Oct., 1930	—
Robinia pseudacacia	512(b)	roots	Biltmore, N. C.	Oct., 1930	—
Robinia pseudacacia	651	stems	Dist. of Col.	Summer, '30	—
Robinia pseudacacia	652	roots	Dist. of Col.	Summer, '30	—
Robinia viscosa	513(a)	aerial	Mt. Mitchell, N. C.	Oct., 1930	337 (3 fish) 1 not dead
Robinia viscosa	513(b)	roots	Mt. Mitchell, N. C.	Oct., 1930	some distress
Spatholobus roxburghii Benth	673	Bark	Rangoon, Burma	Nov., 1929	105

TABLE 1. *Continued*

Plant	I.D. No.	Part of Plant Tested	Where Collected	When Collected	Av. Time of death in Minutes
Symplocos tinctoria (L) L'Her	514(a)	aerial	Biltmore, N. C.	Oct., 1930	—
Symplocos tinctoria (L) L'Her	514(b)	roots	Biltmore, N. C.	Oct., 1930	154
Urechites suberecta	393	aerial?	Jamaica	July, 1930	217
Urechites suberecta	519	leaves	Jamaica?		48
Verbascum thapsus L.	516(a)	aerial	Biltmore, N. C.	Oct., 1930	slight distress
Verbascum thapsus L.	516(b)	roots	Biltmore, N. C.	Oct., 1930	—
Xanthoxylum americanum Mill	517(a)	aerial	Biltmore, N. C.	Oct., 1930	—
Xanthoxylum americanum Mill	517(b)	roots	Biltmore, N. C.	Oct., 1930	2 fish dead 1 fish in great distress
Derris elliptica[2]	612	roots	—	—	92
Sample No. 1[3]	653		Florida	Summer, '30	great distress

[2]Known to contain 1.7% rotenone.

[3]This sample was collected by Dr. Wherry. At this writing no other information can be supplied. The Insecticide Division is making an attempt to identify it so information may be available from that source at a later date.

DISCUSSION OF RESULTS. The extracts tested showed a marked difference in toxicity; some produced no signs of distress in the seven-hour test period, and others killed the fish quickly. For the purpose of comparison, a sample of derris root known to contain 1.7% of rotenone was extracted in the usual manner and then tested against the fish. Death of the fish ensued in an average of ninety-two minutes.

There seemed to be very little correlation between body weight and survival time. It was frequently noted that one fish would withstand the effects of the poison far better than the others of the group.

For convenience the most toxic of the plants are grouped below. Extracts from these plants caused death of the fish in less than one hundred minutes.

TABLE 2. PLANTS MOST TOXIC TO GOLDFISH

Conc. = 1 ml. extract (from .2 g of plant) per liter

Plant	Survival Time of Goldfish in Minutes
Covillia sp	46
Folha tingui	72
Ichthyomethia piscipula	94
Manzanillo Comun	42
Urechites suberecta	48
Ceratiola ericoides	58
Derris elliptica (containing 1.7% rotenone)	92

Scientific Notes

Another Spider becomes a Greenhouse pest. In 1928 (JOUR. ECON. ENT. 21:235) I reported a case where *Erigone atra* Blackw. became objectionable by webbing roses in a greenhouse. On Nov. 10th another case came to my attention at Roslyn, N. Y. This time the principal offender was *Eperigone trident*ata Emerton. Single specimens of *Erigone autumnalis* Emerton and *Araneus cornutus* Clerck were also taken.

C. R. CROSBY

The Colorado Potato Beetle in Utah. The Colorado potato beetle, *Leptinotarsa decimlineata* (Say), has been collected on several occasions in Utah. In 1928 a small infestation was found and apparently eradicated at Morgan, by LeRoy Marsh of the State Department of Agriculture. One adult beetle was collected on the Davis County Experimental Farm at Farmington during 1930, but none have since been taken there. On June 20, 1931, Mr. Marsh discovered an infestation of approximately 1000 immature and adult forms of this beetle on two adjoining town lots at Ogden. Strenuous efforts were made to eradicate this local infestation, and surveys of the surrounding territory showed no spread during the season.

GEORGE F. KNOWLTON, *Utah Agricultural Experiment Station*

An Addition to the Biology of *Rhopalosiphum prunifoliae* (Fitch). In the literature dealing with the apple-grain aphis it has been noted by several authors that apple leaves falling to the ground in early autumn carry with them countless immature sexual females. It has been inferred that such individuals were lost and so had no further part in the life economy of the species. During the past few seasons, the finding of an occasional young female on the lower trunk of defoliating apple trees led the writer to suspect that some other condition might exist; namely, the return of sexuals to the tree. To test this theory a number of trunks were banded with tree tanglefoot soon after the trees started to drop their leaves. Examination of these banded trees, over a six-week period, showed that great numbers of the immature forms regained the trunk and finally, on unbanded trees, relocated themselves on leaves. This occurred to such an extent that it must play a considerable part in the biology of the species.

C. R. CUTRIGHT, *Associate Entomologist, Ohio Agr. Exp. Station, Wooster, Ohio*

Notes on a New Potato Pest. *Gnorimoschema tuberosella* Busck. was described[1] from potato, *Solanum tuberosum* L., the type locality being Lima, Peru where it has been repeatedly reported as an important pest. In Dec. 1930 specimens of a moth, the larvae of which tunnel the stems of nightshade, *Solanum nigrum* var. *douglasii* Gray, were sent to August Busck at Washington. These and subsequent specimens were determined by him as identical with the material from Peru. *G. tuberosella* Busck is very common throughout Ventura and Santa Barbara Counties and undoubtedly extends into other counties of Southern California. At least two parasites are present in this area, one of these is, according to A. B. Gahn, a *Spilochalcis* sp. The insect seems to breed continuously in the field as all stages were found whenever an examination was made.

R. E. BARRETT, *Saticoy, Calif.*

[1]Two new Peruvian Microlepidoptera of economic importance (Gelechiidae and Oecophoridae). Proc. Ent. Soc. Wash., vol. 33, pp. 59-63 March, 1931.

Chemically Treated Bands Destructive to Spider Mites and the Woolly Aphis. Throughout the past five years that the writer has been making tests of chemically treated bands for capturing larvae of the codling moth (*Carpocapsa pomonella* L.), great numbers of the common red spider (*Tetranychus telarius* L.) have been observed in these bands. This season, with the unusual abundance of the mite and of the woolly apple aphis in the orchards of the Wenatchee, Wash. district, the great numbers of the mite and of the woolly aphid (*Eriosoma lanigerum* Hausm.) captured and killed in the bands were again brought strikingly to our attention. Throughout the late summer and fall countless numbers of migrating mites and of migrating woolly aphid nymphs were caught and killed in the bands.

The bands in the foregoing tests were, for the most part, made of corrugated paper or of burlap treated with beta-naphthol dissolved in red engine oil. The bands are placed around the tree trunks early in the summer, preferably just as the earliest codling moth larvae are leaving the fruit, and are allowed to remain until the following spring, when they are removed before any surviving larvae can transform to moths.

Corrugated paper bands have largely superseded the burlap chemically-treated bands, since the latter have been reported as causing some injury, particularly to young trees.

Whether the bands serve to control the mites and the woolly aphid to any appreciable extent has not yet been determined. If they were placed on the trees early in the spring before the migrating mites and the woolly aphid nymphs ascend the trunks, they might well afford some control of both.

M. A. YOTHERS, *U. S. Bureau of Entomology, Wenatchee, Washington*

The Apparent Incompatibility of Barium Fluosilicate and Nicotine Sulphate. During a series of experiments for the control of the tobacco thrips (*Frankliniella fusca* Hinds) on shade-grown tobacco at Quincy, Fla., during the past season, nicotine sulphate was used. An infestation of the flea beetles, *Epitrix parvula* Fab. and *Epitrix cucumeris* Harr., also occurred at the time that the experiments against the thrips were being conducted. Since in another series of experiments a good control of the flea beetle was being obtained with barium fluosilicate, a combination of nicotine sulphate and barium fluosilicate was tested, the materials being mixed as follows: Barium fluosilicate 1½ pounds, nicotine sulphate 12 ounces, water 50 gallons. The mixture was applied to the crop at the rate of 100 gallons per acre immediately after mixing. Two days after the application very severe "burning" was observed on the buds and leaves of the tobacco plants. Later observations showed that the damage did not increase appreciably after this date.

At the same time a nicotine sulphate solution was being used over a considerable acreage of tobacco without any apparent "burning" and barium fluosilicate was being applied to other fields with only a slight trace of foliage injury, the latter material being used at the rate of 4 to 8 pounds per acre. It was, however, moistened by dew and light showers on several occasions.

It is evident from these observations that a combination spray of nicotine and barium fluosilicate is detrimental to tobacco foliage.

F. S. CHAMBERLIN, *Assistant Entomologist, U. S. Bureau of Entomology*

Mesquite Injured by *Orthotylus translucens* Tucker in Arizona. In Cochise and adjacent counties of southeastern Arizona I have been observing during the past ten years that a large percent of the mesquite (*Prosopis glandulosa* and *P. velutina*) fails to develop leaves and flowers at the proper time. Small green structures, apparently distorted leaves, are developed but these dry up and fall. The appearance of the bushes suggests that gnawing insects remove the leaves as fast as they are developed. Abnormal bushes of this type are scattered among normal bushes, or there may be fairly large areas in which practically no normal bushes exist. The first leaves which develop on the abnormal bushes in late spring or early summer are distorted and yellowish in color.

The condition has come to attract the attention of the laity. Various explanations have been advanced, such as winter injury or spring frosts, drought, and even toxic emanations from industrial plants. The last of these must be abandoned because of the existence of the condition at points far removed from any source of such wastes. The relationship of the occurrence of the condition to the topography does not favor the temperature explanation.

Throughout the period of my observations I have detected the presence of small green bugs (mirids) in large numbers. Their droppings often appear conspicuously on the injured twigs. It seems highly probable that these insects are responsible for the abnormal condition of the mesquite. Specimens sent to Mr. E. P. Van Duzee were identified as *Orthotylus translucens* Tucker.

WYATT W. JONES, *Douglas, Arizona*

Hibernation of 13-Spotted Lady Beetle. For the past six years the 13-spotted lady beetle, *Hippodamia tredecimpunctata* L., has been observed hibernating in the irregular pockets on the trunk of a cedar tree near the laboratory at Chadbourn, North Carolina. The tree, about 14 inches in diameter, stands on the western margin of a lawn about 30 feet from the residence. The number of beetles coming to this tree annually for hibernation has greatly increased from year to year.

At noon, October 15, 1931, when the temperature was 84°F. and the relative humidity 45 per cent, it was observed that the beetles were converging in large numbers towards the trunk and lower branches of the cedar. By 2.00 p. m., the trunk in many places was almost completely covered by the lady beetles, especially on the southeastern side. At this time there appeared to be no concerted movement toward the irregular pockets in the trunk, but in most cases the beetles were content to remain where they alighted. Within the next few days the beetles entered the irregular pockets on the tree, concentrating principally on the southeastern side.

By November 1 the beetles in the colony had assumed a quiescent state, and were still more heavily concentrated on the southeastern side of the tree. The prevailing cold winter winds in this section are from the northwest. No other types of trees in the immediate vicinity seemed to have any attraction for the beetles.

W. A. THOMAS, *Entomologist, U. S. Bureau of Entomology*

Comparative Effectiveness of Fall and Spring Applications of Paradichlorobenzene for Peach Borer Control. The use of paradichlorobenzene crystals in the fall at the end of the oviposition period of the peach borer is recommended for the control of that insect. Spring application is suggested if for an unavoidable reason the treatment could not be made at the recommended time in the fall. In such cases, the question of the comparative effectiveness of fall and spring applications

is presented. The following results of experiments conducted during the spring and fall of 1931 furnish data for answering that question.

Plat No.	Number of Trees	Age of Trees	Treated with 1 ounce of paradichlorobenzene Crystals on—	Examined for Borer Control on—	Number Borers Dead	Number Borers Alive	Per cent of Borers Dead
		Years	1931	1931			
1	25	8	April 4	May 15	44	8	84.6
2	10	6	October 14	October 29	17	0	100.0
3	10	6	Check—untreated	"	1	41	2.4

Most of the borers are nearly full-grown by spring, and at that time some have traveled in the tree to a considerable distance from the point where the paradichlorobenzene crystals are placed. These are factors that are perhaps responsible for the poorer results from the spring application. Peach growers will obtain better results from paradichlorobenzene if applied in the fall at the end of the oviposition period of the borer.

OLIVER I. SNAPP and J. R. THOMSON, *U. S. Peach Insect Laboratory, Fort Valley, Georgia*

A Commercial Use for a Destructive Insect. The Japanese have recently begun to use the cases of the "bagworm" or "fagot insect" (Thyridopteryx) for making various articles, particularly ladies handbags. These are rapidly becoming very popular. The outside of the bagworm cocoon is exposed, giving the handbag a rough, leathery appearance. Ladies sport shoes made from these insect cases seem to be satisfactory and are quite a novelty. More and more uses are being found for this material. It seems possible to use it for many articles now made of leather, such as golf bags, belts, card cases, etc.

The insects are collected when they are full grown (1½ to 2 inches long), the larvae removed and the cases slit, after which the loose pieces of leaves or sticks are removed. The larvae may be used for chicken food, though this might be a bad practice from an entomological standpoint as any parasites present would also be destroyed. Each bagworm case will furnish a piece about one inch square, and a number of these are stitched together until a piece of satisfactory size is obtained. Article made of these insect bags are lined with cloth and usually trimmed with leather. "Zipper" clasps are used where desired. The bagworm cases are very tough and materials made from them should be durable.

Bagworms are very common in Japan where they are called "mino mushi", meaning insect with a raincoat, which is derived from their imagined likeness to a rice farmer wearing the shaggy, straw raincoat so frequently seen in rural Japan during the rainy, rice-planting season.

The idea of utilizing these insect bags for practical purposes was contributed by a foreign resident who was looking for work for the many Japanese unemployed. Perhaps it would be possible to use the same idea in those sections of the United States where bagworms are abundant and destructive, thus providing some employment and reducing the numbers of a harmful insect at the same time.

CHARLES A. CLARK, *Kobe, Japan, December, 1931*

The Potato Pin Worm, *Gnorimoschema lycopersicella* Busck, a new Pest in Pennsylvania. In September, 1931, my attention was directed to a small lepidopter-

ous larva, which was causing injury to tomatoes near Coatesville, Pa. This larva proved to be a leaf miner of the family Gelechiidae, but did not exactly correspond with any known Pennsylvania species of this group. A number of adults were reared and sent to Mr. A. Busck of the U. S. National Museum, who determined them as *Gnorimoschema* (*Phthorimaea*) *lycopersicella* Busck. This insect, which was described in 1928 (Proc. Hawaiian Ent. Soc., VII, No. I, June, 1928), has heretofore been found established only in Mexico, California, and Hawaii, where it has caused much injury to tomatoes by mining the leaves, boring into the stems and buds, and making small holes into the stem end of the tomato. This latter type of injury has caused it to be called the tomato pin worm.

This insect is capable of great damage, as is shown by reports of from 40 to 85% infestation in California. During 1930 it caused much injury in the Imperial Valley and other parts of California. In the localized infestation near Coatesville, Pa., it was first noticed during the winter of 1929–1930, about two years after the grower had received shipments of celery and tomatoes from California. The greatest injury has been in this grower's greenhouses, but the insect has also spread to tomatoes planted in the field, where injury was severe during the summer of 1930. In addition to tomatoes it has also infested the Horse Nettle, *Solanum carolinense* L., apparently a new foodplant for this species. As the countryside surrounding this infested farm is heavily infested with this weed, eradication of the pin worm will doubtless be very difficult, if it is not killed out by a severe winter. The infested houses have been thoroughly cleaned out and no tomatoes are being grown in them this winter, so that it is hoped that the only remaining stages are outdoors, where they may be affected by the winter.

The moth of this insect is very difficult to distinguish from the adults of the closely allied *G. glochinella* (Zeller), and *G. operculella* (Zeller), except by means of the genitalia, which are quite distinct. The larva differs from those of the other species by having distinct saddle-like purplish markings on the dorsum of the abdominal segments. This is not found in the other species, nor in the young larvae of this species.

Busck described and figured the genitalia of this and the related species, and Swezey noted its injury in Hawaii, in the above Proceedings of the Hawaiian Ent. Society. An interesting account of its injury in California, with seven references is found in a paper by R. E. Campbell and J. C. Elmore, in the Monthly Bulletin of the California Dept. of Agriculture, XX, No. 7, Sacramento, Cal., July, 1931, p. 458.

C. A. THOMAS, *Penna. State College*

Ethylene oxide-liquid carbon dioxide mixture in house fumigation.—In 1930 a large residence near Minneapolis was fumigated with chloropicrin to rid it of carpet beetles. The gas clung for several weeks to clothes in the wardrobes, resulting in irritation to occupants of the house. Furthermore, the beetles were not well controlled.

"Carboxide" (a liquefied mixture of ethylene oxide and carbon dioxide in gas cylinders) was tried in October, 1931. The house was divided into five floors including attic and basement. As the space involved amounted to approximately 275,000 cubic feet 58 fifty-pound tanks of gas were used. The greatest infestation of carpet beetles occurred in goods stored in the attic where excessive heat of the

last summer had increased the rate of insect development. Rooms immediately below contained a lesser infestation but very few beetles were found on the lower floors.

As the attic was not so tight as the rest of the house a higher charge of gas was used. Ten tanks were placed here in a space of only about 10,000 cubic feet. Throughout the lower floors one or two tanks were placed in each room with extra ones in the halls. The cylinders were placed upright on small squares of wood to prevent marring the rugs. Wherever spray might strike the hangings nozzles were either directed toward woodwork as much as possible or were covered loosely with short pieces of cheese-cloth. All wardrobes and bureau drawers were opened.

As soon as a few of the tank valves had been released it was found that back pressure overbalanced some of the cylinders. Because of possible damage to furniture and woodwork the remaining cylinders were lowered to a horizontal position. In the future the cylinders will be braced, and then the gas will be released more slowly. The attic and parts of the second and third floors were sealed from each other and from the lower rooms. In this way the greater charge of gas was held in the upper part of the building, both to be effective against the greater infestation there and to allow the fumigators time to finish their work.

It was possible to leave the house unoccupied for 48 hours. When it was opened there was no odor of the gas apparent. Ethylene oxide has a "sweetish" odor which is not unpleasant but is a fairly good indicator. In a few cases rugs were spotted by the liquid that came in contact with them when some of the cylinders "froze." Unfortunately, when the tanks were lowered to horizontal positions there was no time to provide newspapers for possible drippings. Spots in the rugs were rather easily removed later, however. The fumigation appears to have been highly successful both from the standpoint of ease of operation and from that of the effectiveness of the control. No live beetles have been found since this house was fumigated.

H. H. SHEPARD and D. L. LINDGREN, *University of Minnesota, St. Paul, Minn.*

A Peculiar Spotting of Oranges in Central California. A peculiar spotting of the rind of oranges and certain other citrus varieties has attracted considerable attention for a number of years. It is characterized by a sinking of the tissue between the oil glands of the rind so that the glands stand out prominently in these affected areas. Dr. Fawcett in 1916 reported (Calif. Agr. Exp. Sta. Bul. 266) on this spotting from the pathologist's viewpoint and he concluded that it was caused by the liberation of minute quantities of oil from the oil cells which spreads out and affects the adjacent tissue. The peculiar injury is more acute on immature fruit and under conditions of humidity. Fawcett believed that any agency causing the rupturing of oil cells, including insects and mites, would contribute to the spotting of the rind.

For several years the writer has entertained the belief that some of this particular injury is caused by the work of leafhoppers. The recent cycle of dry seasons that has occurred in central California has resulted in building up the leafhopper population to a high degree. At the approach of cold weather the hoppers migrate into the citrus groves for greater protection. From about October 15 until the occurrence of killing frosts, swarms of leafhoppers are commonly seen on the citrus foliage. Several species are concerned, including the grape leafhopper, *Erythroneura comes* (Say).

In order to test the validity of the writer's belief, Harold Lewis, of the California Fruit Growers' Exchange (who has worked in close coöperation with the writer during the past few years), confined hundreds of grape leafhoppers with oranges under cloth bags, and bagged other oranges in the absence of hoppers. All navel oranges with confined hoppers soon developed typical rind spots—an average of 4 spots per fruit. Similarly exposed Valencia oranges developed the spotting to a lesser degree—an average of 0.75 spot per fruit. Protected oranges developed no new spots. A conclusion to be drawn from these tests is that leafhoppers are a cause of the typical spotting of the rind.

No doubt other agencies contribute to the sum total of the rind spotting. To test the possibilities from purely mechanical abrasion the writer has punctured oil cells with a very fine needle point, and this has repeatedly led to more or less typical rind spots. The citrus thrips has been suspected of causing a certain amount of this injury, and Mr. Woglum of the California Fruit Growers' Exchange requested that this possibility be looked into. Accordingly the writer confined hundreds of citrus thrips with bagged unblemished navel oranges, but no spots developed. In addition, Mr. Lewis and the writer tagged many green oranges in the rind of which ovipositing thrips had become ensnared. In almost all cases spots were associated with these ensnared thrips when first detected, and it is the writer's opinion that the act of attempting to oviposit into the calloused gummy tissue of the rind spots explains the presence of the thrips at the spots. It is significant that almost no enlargement of these spots (with associated thrips) developed during the course of observation. Furthermore, where thrips were ensnared in the absence of rind spots, no such spots developed. Still, it is possible that ovipositing thrips may at times puncture oil cells and cause a limited amount of the spotting.

E. A. McGregor, *U. S. Thrips Laboratory, Lindsay, Calif.*

An Improved Oviposition Cage for the Codling Moth. In connection with mass rearing of newly-hatched codling moth larvae for insecticide tests, a new type of oviposition cage has been developed at the Vincennes, Indiana, station of the U. S. Bureau of Entomology. It consists simply of a cylindrical tin coffee can approximately 6 inches high and 4 inches in diameter. The bottom is first cut out smoothly. Then a piece of cellophane is placed on the top of the can and the cover forced on over it. This end then becomes the bottom. The inside of the container is next lined with a sheet of cellophane of the proper size and held in place by four or five paper clips around the mouth of the can. If correctly done, the inside of the cage is smoothly lined on the bottom and sides with no spaces left into which a moth might crawl and become trapped. A single piece of cheesecloth held in place by a rubber band covers the top of the cage.

With this type of cage, several kinds of paper and of cellophane were tried in an effort to find some lining material more efficient than waxed paper. Two hundred moths were used per cage and the duration of each test was but four days; therefore the figures given in Table 1 do not represent the total number of eggs available from the moths, but the number of eggs deposited on the different lining materials during the tests are comparable. To induce maximum oviposition, the cages containing the moths were kept in an incubator in which was maintained a constant temperature of 82° F. and a relative humidity of 95 per cent. The only source of

light within the incubator was a dim electric light wrapped in cloth to reduce its intensity.

TABLE 1. SUMMARY OF OVIPOSITION STUDIES OF CODLING MOTHS CONFINED IN CAGES LINED WITH DIFFERENT KINDS OF PAPER AND OF CELLOPHANE, VINCENNES, IND., 1931

Cage lining	Cages	Total eggs	Lining	Laid on— Foliage	Apple	Average eggs per moth
	Number	*Number*	*Per cent*	*Per cent*	*Per cent*	*Number*
Red Cellophane	13	52,649	50.76	37.95	11.29	20.25
Blue Crepe Paper	4	15,458	40.64	43.03	16.33	19.36
Gold Cellophane	4	14,909	59.25	29.04	11.71	18.64
Pink Cellophane	4	14,784	48.85	36.01	15.14	18.48
Green Crepe Paper	5	18,512	20.77	61.33	17.90	18.51
Red Crepe Paper	5	17,555	17.77	64.14	18.09	17.55
Colorless Cellophane	11	35,694	54.31	33.11	12.58	16.22
Apple Wrap Paper	8	25,475	57.07	30.54	12.39	15.92
Blue Cellophane	4	12,717	52.42	34.69	12.89	15.90
Heavy Wax Paper	7	15,962	37.70	43.80	18.50	11.40
Green Cellophane	5	10,913	51.97	37.04	10.99	10.91

The cellophane was .001 inch thick and the several samples were apparently similar in every way except in color. The crepe papers likewise apparently varied only in color. A serious objection to crepe paper is its habit of shrinking in the high humidity of the incubator. Red cellophane seems to be the most promising of the materials tested, since it is efficient, cheap, and easily handled.

Table 2 presents data which indicate that, on the average, greater numbers of eggs per moth were produced when two hundred moths were confined in each cage than when lesser numbers of moths were used.

TABLE 2. INFLUENCE OF NUMBER OF CODLING MOTHS ON EGG PRODUCTION IN OVIPOSITION CAGES. (THE CAGE LINING WAS APPLE WRAP PAPER)

Moths per Cage	Cages	Eggs	Average Eggs per Moth
Number	*Number*	*Number*	*Number*
25	2	339	6.78
50	2	1,228	12.28
75	3	1,832	8.14
100	3	3,934	13.11
125	1	483	3.86
200	8	25,475	15.92

R. F. SAZAMA, *Assistant Entomologist, U. S. Bureau of Entomology*

The Residue Problem and Fluorine Compounds. Fluorine compounds are being used to an increasing extent to meet the arsenical residue problem. It is thought by many people that these compounds are perhaps as objectionable from the standpoint of public health as lead arsenate. Since no tolerance has yet been named for them, a review of the literature relating to both the chronic and acute toxicity studies should be helpful to persons interested in the effect of fluorine compounds on the human system.

ACUTE TOXICITIES.—Kuhn (Tran. Fourth Int. Congress 1928) determined the acute toxicities as follows:*

	M. L. D.			
Calcium arsenate	38	mg. per	Kilo	(dogs)
Lead arsenate	500	" "	"	(dogs)
Lead arsenate*	75	" "	"	(rabbits)
Sodium fluosilicate	150	" "	"	(dogs)
Sodium fluoride*	200	" "	"	(rabbits)
Barium fluosilicate*	175	" "	"	(rabbits)
Cryolite	500	" "	"	(not fatal)

In the foregoing data the minimum lethal dose for the fluorine compounds is somewhat less than for the arsenicals, especially in the case of cryolite.

CHRONIC TOXICITIES.—Of prime concern from the standpoint of public health is the possible chronic rather than acute action of fluorine on the system, as compared with arsenic. Sollman (Jour. Phar. and Expt. Ther. 1921) fed albino rats for 9 to 24 weeks with arsenic trioxide, and as little as .00005 to .0005 mg. per kilo produced a distinct retardation of growth. These daily doses are only 1/800 to ¼ of the U. S. P. therapeutic dose of 2 mg. On the other hand, Sollman (Jour. Phar. and Expt. Ther. 1921) fed sodium fluoride in daily doses of 8 mg. per kilo with no deleterious effect on growth or food consumption within 9 weeks. Schultz and Lamb (Science, p. 93, 1925) report no ill effects from .05 per cent sodium fluoride (equivalent to 226 parts of fluorine per million of foodstuffs) when fed to rats. Beyond those dosages a toxic effect was observed. Similar results were secured by McClure and Mitchel (Jour. Biol. Chem. 1931). The feeding of raw rock phosphate as a mineral supplement to dairy cattle has been found detrimental, dut to the fluorine content, Taylor (Quart. Bul. Mich. Agr. Exp. Sta. 1929). The basal ration used was 1½ per cent raw rock phosphate, equivalent to 450 parts of fluorine per million. Gautier and Clausman (Comp. rend. 162, 105, 1916) found natural foods to contain, on the average, 26.5 parts of fluorine per million. Since the average spray residue contains less than 3 parts per million of foodstuffs, it appears that we are all consuming considerably more fluorine in our daily diet than would be possible from consuming fruits or vegetables sprayed with fluorine.

From these data the following conclusions seem evident: That both fluorine compounds and arsenicals have high acute toxic values. As to the chronic toxicities, with which we are primarily concerned in the residue problem, the fluorine compounds are at least 100,000 times safer than lead arsenate and possess a marginal safety factor over the average spray residue content of 75. The 1931 report of the California Agricultural Experiment Station contains this statement with respect to the residue from fluorine compounds: "From a number of chemical analyses made by the Bureau of Chemistry, at Washington, D. C., it would seem that on vegetables which are washed before marketing there is not sufficient residue to be dangerous for human consumption even though dusted excessively."

S. MARCOVITCH, *Tennessee Agricultural Experiment Station, Knoxville, Tenn.*

The Relative Toxicity of Rotenone and Some Related Compounds as Stomach Insecticides. The Insecticide Division of the U. S. Bureau of Chemistry and Soils has submitted to the writers four pure compounds extracted from certain fish-poison

*Cited from C. W. Muehlberger (Jour. Phar. and Expt. Ther. 1930).

plants and five derivatives of rotenone for determination of their relative toxicity as stomach poisons. At the request of the Insecticide Division the following notes are presented, although the results, owing to a lack of sufficient material, are not as precise as they might be.

The leaf-sandwich method, described by Campbell and Filmer (Trans. IV. Internat. Cong. Ent. Ithaca, 523–533. 1929) and modified by Campbell (Jour. Econ. Ent. 23: 357–370. 1930), was used with fourth-instar silkworms as the test insects. In 1929 the junior author determined the median lethal dose (M. L. D.) of rotenone to be close to 0.003 mg. per gram of body weight. In 1930 the senior author, now at the University of Minnesota, tested eight more compounds. For the sake of comparison in the following tabulation of results, the M. L. D. of acid lead arsenate and of rotenone are given:

Rotenone	M. L. D. approximately	0.003	mg./ gm.
Dihydrorotenone	M. L. D. not more than	0.01	" "
Deguelin	M. L. D. between 0.01 and	0.012	" "
Tephrosin	M. L. D. between 0.03 and	0.06	" "
Acid lead arsenate	M. L. D. approximately	0.09	" "
Toxicarol	recovery from doses as high as	1.54	" "
Derritol	recovery from doses as high as	0.87	" "
Rotenol	recovery from doses as high as	0.51	" "
Dehydrorotenone	recovery from doses as high as	0.40	" "
Tubaic acid	recovery from doses as high as	0.54	" "

It will be noted that the first four compounds are more toxic than the standard stomach poison, acid lead arsenate. Rotenone, which is about 30 times as toxic as acid lead arsenate, is the most toxic substance for the silkworm as yet tested by the leaf sandwich method. However, it must not be assumed that rotenone is equally as toxic as a stomach insecticide for other insects. Wide differences in effectiveness of rotenone noted in recent tests by others suggest that the degree of its toxicity may depend on the physiological characteristics of the species of insect and its food. Rotenone and related compounds are not repellent to the silkworm, which may therefore take many times the quantity of the median lethal dose. Their action is so slow and mild that the larvae neither regurgitate nor undergo spasms as is often the case in poisoning by arsenicals and fluorine compounds.

The last five compounds in the foregoing list could not be arranged in the order of their relative toxicity, because none of the insects died from the doses that were given. However, the results do show that these compounds are either non-toxic or of so low an order of toxicity as to have no possibilities for practical use.

Rotenone, deguelin, tephrosin, and toxicarol, the four naturally occurring compounds, were given the same order of relative effectiveness as contact poisons by Davidson (Jour. Econ. Ent. 23: 877–879. 1930) as that found by the writers for their relative toxicity as stomach poisons.

Of the five derivatives of rotenone, only dihydrorotenone approached the toxicity of rotenone. The decrease in toxicity of rotenone when allowed to stand in solution in certain organic solvents (Davidson and Jones, Jour. Econ. Ent. 24: 257–262, 1931) is probably due to its spontaneous oxidation to dehydrorotenone (Jones and Haller, Jour. Amer. Chem. Soc. 53: 2320–2324. 1931), a compound having little or no toxicity for the silkworm. The results so far obtained indicate that deriva-

tives and degradation products of rotenone are likely to be less toxic than rotenone itself.

H. H. SHEPARD and F. L. CAMPBELL, *U. S. Bureau of Entomology, Takoma Park, Maryland*

The Beech Scale (*Cryptococcus fagi* Bärenspr.), Recently Discovered in New England. The beech scale (*Cryptococcus fagi* Bärensprung) has long been known as a common pest of beech in Europe. The late Dr. C. Gordon Hewitt reported its discovery in Nova Scotia in 1911, indicating that it had been present there for at least 20 years. In recent years its occurrence in Nova Scotia, and in New Brunswick and Prince Edward Island, has attracted considerable attention and it has been stated that many infested trees in these Canadian Maritime Provinces have died. So far as known only beech it attacked, the American beech (*Fagus grandifolia*) being as severely infested as the European species (*Fagus sylvatica*), and at least most of the investigators who have studied infestations in Europe and Canada are of the opinion that certain fungi and slime-fluxes that appear on scale-infested trees cause more injury than the scale itself.

There appear to be no published references to the occurrence of the beech scale in the United States, but Mr. John Ehrlich, a graduate student at Harvard University, who has carried on investigations having to do with the occurrence of the species in the Canadian Maritime Provinces has stated in correspondence that he found the scale to be present in Boston in 1929, its identity being determined by Dr. Harold Morrison of the United States Bureau of Entomology, and by Dr. Edith M. Patch of the Maine Agricultural Experiment Station. Mr. Ehrlich intends publishing an article in the January number of the Journal of the Arnold Arboretum which includes his observations on the insect in New England.

In March, 1931, Mr. S. S. Crossman, of the Plant Quarantine and Control Administration, who was then stationed at Melrose Highlands, Mass, obtained specimens from beech trees growing in the Middlesex Fells Reservation, Stoneham, Mass. During the summer and fall of 1931 members of the station spent considerable time in various portions of the New England States searching for the scale. Two types of scouting were carried on. In both, the idea was to look for beech trees and when these were seen they were examined. Some towns were scouted lightly, only the principal roads being traveled. Other towns were scouted more thoroughly, all sections of the town being visited. Up to November 12 three distinct areas where infestations occur had been located. One area is in Liberty, Me., between Augusta and Belfast. Another includes Gloucester, Essex, Manchester, and Beverly, in the "North Shore" section of Massachusetts near Cape Ann. The third includes Boston and the neighboring cities and towns of Stoneham, Belmont, Cambridge, Watertown, Newton, Brookline, and Milton. The number of trees found infested at various points in Massachusetts ranges from one or two to several hundred. The infestation in Liberty, Me., is more widespread. Mr. H. B. Pierson, State Entomologist of Maine, who has done additional scouting in that section since Bureau of Entomology representatives found the scale there, reports that it occurs throughout the town as well as in the adjoining town of Washington. Evidence of slime-flux has been noted on infested trees in Beverly, Mass., but certain fungi which are said to be very injurious to such trees in Europe and Canada have not been found in New England.

Members of the Bureau of Entomology stationed at Melrose Highlands, Mass., have carried on experiments with certain spray mixtures for the control of the scale and, based on their findings, are advising the use of a miscible oil at the rate of 1 gallon to 15 gallons of water at the beginning (first two weeks of November in the vicinity of Boston) or end (first two weeks of April in the vicinity of Boston) of the dormant season. Because of the limited time during which these experiments have been conducted, however, it may be advisable later to change the recommendations. Considerable spraying for the control of the insect has already been done in Massachusetts by State, city, and town authorities, and by property owners.

Besides continuing control experiments, and making certain studies concerning the life history and habits of the beech scale, and the injury caused by it, the Bureau of Entomology will consider the possibility of introducing natural enemies.

A preliminary survey indicates that the insect is spread over a rather limited area at present in New England and that the infestations in Massachusetts at least are in areas where native beech is not abundant. There is more or less of a natural barrier between the present known infested areas in Massachusetts and that of natural beech forests in western Massachusetts, northern New Hampshire, and Maine. More scouting should be done to determine the present limitations of spread, and if conditions are found to be similar to those already known to exist, systematic methods of control should be practiced to prevent its early establishment in the natural beech stands of New England.

C. W. COLLINS, *U. S. Bureau of Entomology*

THE NINTH ANNUAL MEETING OF THE ENTOMOLOGICAL SOCIETY OF PENNSYLVANIA

This was held in Harrisburg, Pennsylvania, on the afternoon of January 18th. President H. N. Worthley presided.

The program was informal, no papers or set speeches being given. The society discussed the possible publication of a check list of the insects of Pennsylvania. Affiliation of the society with the Pennsylvania Academy of Science was also discussed. C. A. Thomas reported upon the Tomato Pin Worm Moth, an insect recently introduced into Southeastern Pennsylvania from California. J. O. Pepper presented results of tests with various sprays against San Jose Scale. H. N. Worthley discussed results of delayed dormant sprays against scale and also effects on scale population of various fungicides. The officers elected for 1932 were: J. R. Stear, President and A. B. Champlain, Secretary.

Following the meeting, the members dined together informally. The following members and visitors were present: A. B. Champlain, C. A. Thomas, C. C. Hill, J. S. Pinckney, G. B. Stichter, E. J. Udine, H. N. Worthley, J. R. Stear, T. L. Guyton, R. H. Bell, F. L. Holdrige, J. O. Pepper, J. N. Knull, Clair Van Horn, Mr. Luginbuel and Mr. Duncan.

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The editors will thankfully receive news matter and other items likely to be of interest to our readers. Papers will be published as far as possible in the order of reception, except that papers of reasonable length may be accepted in the discretion of the editor for early publication at $3.00 per page. There is a charge of $3.00 per page for all matter in excess of six printed pages, a part page counting as a full page, this limit not including acceptance illustrations. Photo-engravings may be obtained by authors at cost.

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A. A. A. S. Winter meetings: 1932-33 Atlantic City; 1933-34 Boston; 1934-35 Pittsburgh; Summer meetings: 1932 Syracuse, 1933 Chicago, 1934 San Francisco.

Those who were privileged to attend the New Orleans meeting will recall with great satisfaction the beauties of the city and the uniform desire on the part of all to make the occasion a pleasant one. The Entomologists' dinner was as usual highly successful. An outstanding feature was the very fine vocal selections rendered by a quartet from the Southern University of Baton Rouge.

There was an exceptionally heavy program at the New Orleans meeting, 104 papers being listed, most of them with the usual five minute limit for presentation. There were frequently three simultaneous sessions of economic entomologists, and in addition there were the meetings of the Entomological Society of America. Fortunately, it was possible to have all of these under one roof and fairly near each other. This made it easy to pass from one session to the other, though it usually was not possible to hear all the papers in which one was particularly interested. This was not due to faulty management. It was simply a condition inherent upon the presentation of numerous papers within a necessarily very limited time. Presumably there was no better way of meeting the needs of those in attendance. Even after the titles were filed with the Secretary, more or less adjustment was necessary, owing to unavoidable absences of authors. Even in the case of the invitation papers, but two of the four were actually presented.

Reviews

Insect Pests of Farm, Garden and Orchard by E. DWIGHT SANDERSON, Third Edition, revised and enlarged by LEONARD MARION PEAIRS, pages I–VII, 1–568, 607 text figures, New York, John Wiley & Sons, Inc., 1931.

This work, well and favorably known in the two earlier editions, has been largely re-written in order to bring the subject matter down to date. The same general plan has been followed as in the previous editions, the bulk of the work consisting of very readable practical accounts of the various species with especial reference to control measures. There are an exceptionally fine series of illustrations, the authors having reproduced the latest and best in the literature. The graphs illustrating distribution, life histories, etc. are important features.

This edition, like its predecessors, covers a wide field and will prove of great service not only to the practical men interested in control measures, but also to entomologists desirous of a concise summary in regard to an injurious insect or especial problem in relation thereto. The work is admirably planned, the mechanical features are excellent, and both authors and publishers are to be congratulated upon the many admirable features of the book. This new volume on insects cannot but prove a valuable addition to many general libraries as well as to the numerous special collections of books dealing with insects.

E. P. F.

Chemical Embryology by JOSEPH NEEDHAM, Fellow of Gonville and Caius College, Cambridge; and University Demonstrator in Biochemistry. 3 Volumes. pp. I–XXI, 1–2021, 12 plates, 532 figures. Cambridge, at the University Press. New York, The Macmillan Co.

This enormous and comprehensive treatment attempts to discuss all of the chemical changes and phenomona taking place during the development of the embryo. A complete review of the history and previous research is given. The work contains an exhaustive bibliography of 241 pages including some 7000 titles. All the important data obtained by these many workers are presented, together with their respective points of view regardless of whether the work is of value or importance in Dr. Needham's opinion. The presentation of all material has been greatly augmented by the inclusion of much data in the form of graphs, curves and simplified charts. These graphs alone are sufficient to give a very clear conception of many of the problems discussed by the author.

Dr. Needham treats the subject under three general headings: I. The Theory of Chemical Embryology; II. The origin of Chemical Embryology as a Science; and III, The General Subject Matter. Under the third division the author discusses Physico-chemical and biochemical problems and phenomena. The problems of embryo metabolism,—organic and inorganic,— and the factors effecting metabolism are discussed in detail. Other problems treated are Ontogenesis, Resistance and Susceptibility in Embryonic Life, Serology and Immunology, Biochemistry of the Placenta, and Placental Barrier. The Amnionic and Allantoic Liquids, Blood and Tissue Chemistry of the embryo are considered.

The author has made a comparison of marine embryos, terrestial invertebrate embryos, and the lower vertebrate and mammalian types. He contrasts from a chemical point of view, the environments of salt water, air, and the body of the mother animal, from which the embryos of each type obtain moisture, oxygen, food, warmth, etc. He presents a large amount of data relative to insect embryology, certain portions are devoted to the discussion of phases of insect embryology.

Of special interest to the entomologist is a portion on the chemical changes during metamorphosis of insects, which is included as appendex III, and contributed by Miss Dorothy Needham. In this chapter changes in weight, CO_2 production, and Carbohydrate and fat changes during pupation are shown by graphs. Protein changes are shown in relation to silk spinning, production of chitin etc. Many other interesting data and phenomona are presented regarding chemical composition or change during metamorphosis.

D. M. DeLong

Handbook of the Insects and Other Invertebrates of Hawaiian Sugar Cane Fields by Francis X. Williams, with an Introduction by F. Muir, a Chapter each on the Soil Fauna of Sugar Cane Fields and on the Nematodes Attacking Sugar Cane Roots by R. H. Van Zwaluwenburg, and Records of Introduction of Beneficial Insects into the Hawaiian Islands, by O. H. Swezey. Experiment Station of the Hawaiian Sugar Planters' Association, octavo, pp. 400, fig. 190, pl. 41, bibl., index. Honolulu, 1931.

This very complete ecological study of all the small animals affecting sugar cane production in Hawaii leads, in its extended ramifications, to a discussion of what one might think to be the greater part of the rather limited fauna of these remote islands. Primarily intended for local cane planters and field men, it is intensely interesting to sugar cane entomologists anywhere in the world, and because of certain unique features connected with the development of entomology in Hawaii, to all workers with parasites. Indeed, the introductory chapter by Dr. Muir, discussing both the theory and the practice of parasite introduction, will for some of us be by far the most valuable feature of the book. Whether one can entirely agree with him or not, he has one unanswerable argument on his side: that parasite introductions in Hawaii are practical and commercial successes. At the present time especially, when controversy on some aspects of parasite introduction and artificial rearing of parasites tends to become rabid, this temperate statement is most welcome. The final record of all the beneficial insects introduced, together with those which were introduced but failed to become established, gives hope and encouragement to all entomologists working on smaller and less well-financed projects.

The fact that parasites form such an important and dominant part of the book should not be allowed to obscure the merit of other sections dealing with the pests, quite as competently treated, but of course largely of local interest. The bright blue cover of the book makes it distinctive among others bound in duller hues, as do the numerous and excellent illustrations, giving a wealth of fresh examples of insects of all orders.

George N. Wolcott, *Entomologist, Experiment Station, Isabela, Porto Rico*

Die Tierische Schädlinge des Ackerbanes by SOPHIE ROSTRUP and MATHIAS THOMSEN, Paul Parey, Berlin. 1931. 367 pages, 236 text figures. Price, Rm. 18.

This is the fourth Danish edition translated into German by Drs. H. Bremer and R. Langenbuch; and the original text has been modified somewhat in order to make it more applicable to German conditions. As the title indicates, the book deals with the animal pests of field crops, and it is intended primarily for the use of teachers of agriculture, students, and practical growers. Scientific terminology and morphological and systematic descriptions have been limited as much as possible. Particular stress is laid upon pests of major importance, others being more briefly treated.

The subject matter is arranged according to the systematic grouping of the animals concerned, which include nematodes, annelids, arthropods, and molluscs; and approximately three-fourths of the volume is devoted to insect pests. The morphological description, biology, and economic importance of each group are treated briefly, following which the important members of that group are dealt with individually in regard to the appearance of the species, its life cycle and habits, the manner in which it injures crops, and control measures. Particular attention is given to those factors which affect the abundance of the species, and the carrying out of certain cultural practices, as preparation of the land, fertilization, time of planting, cultivation, thinning, rotation of crops, and so forth, in such a manner as to diminish the extent of injury is emphasized. Insecticides are treated briefly, and where the use of these materials appears feasible, recommendations for their application are made. The authors take the sane and logical view that it is better where possible to adjust agricultural practice so as to minimize injury by pests than to protect the crops by destroying large numbers of insects which have been allowed to accumulate. At the end of the text is a key to the injurious forms arranged according to their host plants and the types of injury caused. A bibliography of important references is appended.

Although the material is presented in non-technical language, the book contains a wealth of valuable information and should interest the American entomologist in that it includes the results of observations on the economic importance and control of not only a number of potential pests to American agriculture, but also a number of old acquaintances, as the bean aphid, Hessian fly, European corn borer, carrot rust fly, cabbage maggot, and so forth. The conditions under which these injurious animals become abundant in their native habitat and the means taken to avoid these conditions are instructive in view of the status of the same or allied forms here. The book is well written and illustrated.

ROGER B. FRIEND, *Connecticut Agricultural Experiment Station*

Current Notes

Gypsy moth scouting in southern Quebec, Canada, was terminated on Nov. 13, again without any trace of the insect having been found.

Mr. A. D. Pickett, Provincial Entomologist, Wolfville, Nova Scotia, has obtained leave of absence in order to engage in graduate work at Macdonald College (McGill University).

Mr. Henry L. Viereck, Specialist in the Hymenoptera, died as the result of an automobile accident at Londonville, Ohio, October 8, 1931.

Dr. George G. Atwood for 30 years Director of the Bureau of Plant Industry, New York Department of Agriculture, died December 6, 1931, at Clearwater, Fla.

T. F. McGehee of Holly Springs, Miss., began work as a scout on Argentine ant work on October 29. He was assigned to Louisiana and left on November 4 for duty.

Members of the Bureau of Entomology in Washington, D. C. have recently been notified of the election of Dr. L. O. Howard to honorary membership in la Societe Linneenne de Bordeaux.

Dr. W. H. Brittain, Macdonald College, attended the recent meeting of the Ontario Entomological Society of Guelph. Dr. Brittain was elected president of the Society for the ensuing year.

Mr. Geoffrey Beall, temporary Junior Entomologist at the Chatham, Ontario Laboratory, terminated his appointment on Sept. 15, and is now taking post-graduate work at the University of Illinois.

Messrs. M. L. Prebble, W. A. Reeks and J. M. Cameron, Junior Entomologists (Temporary) and Mr. I. E. Thomas, Insect Pest Investigator of the Dominion Entomological Branch are now taking graduate work at Macdonald College (McGill University).

Professor George H. Lamson, head of the Department of Zoology and Entomology, and Dean of Science and Arts at the Connecticut Agricultural College, Storrs, Conn., died suddenly December 4, 1931.

Mr. P. B. Dowden left Budapest on September 17, returning to the Melrose Highlands, Mass., station. He was chiefly occupied until this time in bringing the biological work on *Lydella nigripes* and *Zenillia libatrix* to a close and making preparations for his departure.

From October 29 to November 1 the Hyeres, France laboratory was honored with a visit by Dr. L. O. Howard and his daughter Miss Janet Howard. On November 1 they left for Paris, where Dr. Howard expects to remain until the convention of the International Entomological Congress next summer.

An arrangement has been made by the Entomological Branch for the cooperation between the Forest Insects Division and the Canadian Pulp and Paper Association, and other forest organizations, in an investigation of the deterioration in pulpwood between the time of cutting and its utilization at the mill. Mr. E. B. Watson has been placed in charge of this investigation.

In late September and October, the Entomological Branch staff of the Treesbank, Man., laboratory made a survey of the grasshopper situation in Manitoba. As a

result of this work it has been found that, with normal conditions prevailing, eastern Manitoba will probably experience next year, the most serious outbreak of grasshoppers that has yet threatened the crops of the province.

Mr. H. Richmond, Entomological Branch, reports the result of an interesting experiment in host selection with *Dendroctonus monticolae* Hopk. As in previous similar experiments with this species, a definite preference was indicated for yellow pine whether the beetles had emerged from yellow pine or from lodgepole pine. Indications are accumulating that in southern British Columbia *D. monticolae* prefers yellow pine and that outbreaks in lodgepole pine are a constant menace to neighboring yellow pine stands.

During November, Mr. R. Glendenning, Entomological Branch, made a survey of the lecanium scale infestation in Vancouver. The survey revealed that the scale has markedly declined, and 50 to 75 per cent of the scales found contained eggs of the parasite *Blastothrix sericea*. Accordingly, Mr. Glendenning was in a position to notify the Vancouver Parks Board that owing to the introduction of the above parasite by the Entomological Branch no money would be required for control operations against the scale this winter.

The 68th annual meeting of the Entomological Society of Ontario was held at the Ontario Agricultural College, Guelph, November 19–21. Among the officers of the Entomological Branch who attended these meetings were the following: Messrs. Arthur Gibson, H. G. Crawford, Norman Criddle, W. A. Ross, W. G. P. Garlick, H. F. Hudson, A. A. Wood, A. B. Baird, G. M. Stirrett, R. H. Painter, C. S. Thompson, T. Armstrong, W. E. Steenburg, A. G. Dustan, R. W. Sheppard, Geo. Wishart, A. R. Graham, W. A. Fowler, C. W. Smith, D. A. Arnott, W. E. Lindsay, F. J. Hudson, L. L. Reed and F. W. Gregory. Many interesting papers dealing with various entomological subjects were presented and an excellent address entitled "Our Ignorance Concerning Insects," was delivered by Dr. Frank B. Lutz of the American Museum of Natural History, New York.

During the first two weeks of September, the Entomological Branch, at Ottawa, was paid a visit to Dr. H. A. Eidmann, Professor of Forest Entomology at the Forest Insect Institute at Munden, Germany. Dr. Eidmann had spent some time earlier in the season in the Labrador peninsula, and during his visit to the Branch he spent several days at the field station at Laniel, Que., with Mr. Dunn. Dr. Eidmann is one of the foremost forest entomologists of the present time and has had a wide experience in tropical countries as well as in central Europe.

H. A. Jaynes, Associate Entomologist, Bureau of Enotmology, at Trujillo, Peru, left there on September 6 arriving in New York on September 21, returning to Washington, D. C., where he remained till the end of the month, going over the work of his project. Mr. Jaynes left Washington on Oct. 6 for New Orleans to confer with T. E. Holloway on the importation of parasites and to look over the field where the parasites had been released. While in Louisiana he visited Houma from October 19 to 23, inclusive, and Baton Rouge on October 27, where he conferred with Dr. Hinds and met several men at that Experiment Station. He visited Donaldsonville on October 28 and 29 and also spent considerable other time in the field by making short trips out from New Orleans.

Through the efforts of the Division of Forest Insects, Entomological Branch, an airplane survey was conducted by the Dominion Air Service in cooperation with the

Quebec Forest Industries Limited, to determine the extent of territory in the Gaspe peninsula infested by the white spruce sawfly. The result of this survey is very satisfactory, giving a definite picture of the extent of the whole outbreak and the areas where the infestation is particularly severe. It was found that the forest over the cent al part of the peninsula is seriously affected, the outbreak extending over both sides of the central mountain ranges. The information obtained in this survey, together with ground work that has been done and is to be done, in early spring, will be of great value both to the Branch and the limit holders concerned.

Horticultural Inspection Notes

L. E. Myers, Scale Insect Specialist of the Mississippi State Plant Board, resigned recently to accept a position with the California State Department of Agriculture at Los Angeles, California.

Mr. W. H. Wicks, Acting Director of the Bureau of Plant Industry of Idaho, reports that a quarantine to prevent the introduction of the black locust borer into that State is under consideration.

Mr. C. N. Partington, who has been engaged in port inspection work at Philadelphia since July 1, 1931, resigned effective December 31, 1931, to take post-graduate work at the University of California.

The Southern Plant Board met at New Orleans on December 28. Restrictions on the intrastate movement of peach nursery stock to prevent the further spread of the phony peach disease, was among the subjects discussed.

A port inspection station was established at Blaine, Washington, January 11, 1932, and Mr. J. W. Stanton was transferred from Seattle to take charge of the inspection work there under the general supervision of Mr. A. G. Webb.

The Missouri Plant Commissioner issued a regulation on August 31, 1931, requiring a certificate and permit for shipping sweet potato plants or the roots for seed into the State. The certificate relates to "dangerous diseases and insect pests."

More than twenty seniors and graduate students are enrolled in a course in Plant Quarantine Principles and Inspection Methods offered for the first time at the Mississippi A. & M. College. George F. Arnold, Chief Inspector of the Mississippi Plant Board, is principal instructor.

Among those attending the annual meetings of the American Association for the Advancement of Science in New Orleans were twenty-two representatives of the Mississippi State Plant Board and six members of the Department of Entomology of the Mississippi A. & M. College.

A revision of the Japanese beetle quarantine regulations has been issued by the Secretary of Agriculture effective January 1, 1932. The distinction between generally infested and lightly infested areas is discontinued, and material modifications are made in the restrictions on farm products shipments.

The Plant Quarantine and Control Administration, in cooperation with the Bureau of Plant Industry, has set up a system of checking on freight, express and mail shipments of nursery stock in and from the Southern States, in connection with the suppression of the phony peach disease and the prevention of its spread.

The Plant Quarantine and Control Administration was represented at the New Orleans meetings of the National Plant Board, the Southern Plant Board, the American Association of Economic Entomologists, and the American Phytopathological Society in December by Mr. W. A. McCubbin, senior pathologist of the Division of Foreign Plant Quarantines.

Messrs. S. R. Morris, C. L. Parnell and J. H. Miller formerly engaged on the pink bollworm project were transferred to the Mexican Border Inspection Service during the month of December, 1931. Mr. Morris has been assigned to the port of Brownsville, Mr. Parnell to Mercedes and Mr. Miller to Del Rio, Texas.

Under an amendment of the Arizona quarantine relating to the alfalfa weevil, Idaho-grown onions may enter in car lots, or in mixed car lots of onions and potatoes, under special certification and requirements similar to those in effect as to Idaho-grown apples and potatoes. The amendment was dated November 10, 1931.

During the annual meetings of the American Association for the Advancement of Science in New Orleans, the quarantine and inspection officials of Missouri, Georgia, Florida, Tennessee, Mississippi, and Louisiana enjoyed an interesting trip to the orchid greenhouses of E. A. Farley of the Gentilly Terrace Nursery, and were later the guests of the Reuter Seed Company for dinner. This delightful trip was arranged by T. F. Catchings and other employees of the Louisiana Department of Agriculture.

The Mississippi alfalfa weevil quarantine (Rule 42), as recently modified, no longer requires the fumigating of nursery stock. The quarantined territory, which formerly included 7 infested States in entirety, now includes only 4 in entirety (Utah, Nevada, Idaho and Wyoming), and certain counties in the remaining 3—California, Colorado, and Oregon.

The Alabama State Board of Agriculture issued a regulation, effective December 10, 1931, stating that "from careful investigations, it is evident that the fruit and vegetable industry of Mobile County, Alabama, will no longer be endangered if Florida citrus fruits are allowed entry into that County." Accordingly, Florida citrus fruit (for eating purposes) may now be brought into any part of Alabama.

Messrs. Max Kisliuk, Jr. and C. E. Cooley who have been engaged in a special fruit fly survey of the West Indies and certain South American countries since May, 1931, have, in the course of their work, visited the following localities: Antigua, Barbados, Dominica, Dominican Republic, Guadaloupe, Haiti, Martinique, Jamaica, Bahamas, Nevis, St. Kitts, St. Croïx, St. John, St. Thomas, St. Lucia, St. Vincent, Trinidad and Brazil. At the present time they are in Uruguay.

The sweet potato inspection work of the Mississippi State Plant Board more than doubled during the past season, the acreage under inspection increasing from 3,583 in 1930 to 7,980 in 1931. Two grades are now recognized—Grade A, in which no disease whatever has been found in either field or storage inspections; and Grade B, in which a minimum amount of disease is tolerated. More than one hundred additional nurseries also began business in Mississippi during 1931, further increasing the amount of inspection work to be done.

The Oklahoma quarantine on the sweet potato weevil was amended on September 17, 1931, to require certificates of inspection for black rot, stem rot, and Texas root rot "or any other destructive plant parasites." Special restrictions apply in the case of States or areas infested with sweet potato weevil. Certificates are required for

every shipment from all States. The restricted articles include sweet potatoes for all purposes, as well as sweet potato plants.

The vacancy in the State Plant Board of Mississippi and the Department of Entomology of the Mississippi A. & M. College, resulting from the appointment of Professor R. W. Harned as Principal Entomologist in charge of Cotton Insect Investigations for the United States Bureau of Entomology, has been filled by the appointment of Clay Lyle, formerly General Inspector of the State Plant Board and Associate Professor of Entomology. George F. Arnold, formerly Quarantine Inspector, has been given general supervision of all inspection work with the title of Chief Inspector.

The Southern Plant Board met at New Orleans on December 28 with a full attendance. The subjects discussed included the Argentine Ant Surveys, Phony Peach Disease Quarantine Regulations, and the West Indian Fruit Fly Eradication Program. The following officers were elected for the year 1932: President, B. P. Livingston; Vice-President, J. M. Del Curto and Secretary-Treasurer, J. H. Montgomery.

The National Plant Board held its annual meeting at New Orleans, Louisiana, on December 29. The following members were present: Messrs. O'Kane and Adams from the Eastern Plant Board; Messrs. Ruggles and Dean from the Central Plant Board; Messrs. Yeomans and Leiby from the Southern Plant Board and Messrs. Fleury and Schweis from the Western Plant Quarantine Board. The members discussed a suggested form of cooperation on the part of the Post Office Department in the enforcement of State Plant Quarantines, the need of a synopsis of State Nursery Inspection Regulations, and the West Indian Fruit Fly Eradication Program. Messrs. O'Kane and Leiby were elected Chairman and Secretary, respectively.

The Florida State Plant Board, on December 5, 1931, repealed its rule No. 29 which heretofore prohibited the entry into that State of citrus fruit from Texas, Louisiana, Mississippi, Alabama, and Georgia. This action of the Board in no wise affects the status of citrus nursery stock which continues to be excluded from all States and countries.

An amendment to the Minnesota Nursery Inspection law which became effective in April, 1931, gives the State Entomologist authority to condemn nursery stock which is dead or seriously weakened by drying, excessive heat, or cold, or other conditions. It also requires that nursery stock shall be stored or displayed under conditions which will maintain its vigor. Heretofore, the Entomologist's authority has been limited to insect pests and plant diseases.

The Federal quarantine on account of the phony peach disease was revised effective November 30, extending the quarantined area to cover the entire States of Alabama, Georgia, Louisiana, Mississippi, and South Carolina, and parts of the States of Arkansas, Florida, Illinois, North Carolina, Tennessee, and Texas. The regulations restrict the interstate shipment of peach and nectarine trees and roots, from and between the regulated areas of the quarantined States, to nursery stock which has not been grown to within a mile of a known phony peach disease infection.

Mr. E. C. Mandenberg, In Charge of Orchard and Nursery Inspection for the Michigan State Department of Agriculture, reports that in spite of the depressing times the volume of inspection work has increased and that fee collections have been

about one-third higher than fee collections of a few years back. The Department suffered a reduction in funds when the Legislature met last winter and has had to curtail the inspection staff considerably. The remaining staff inspectors are C. A. Boyer, A. H. Beyer, and O. K. White, who have for several years been full time employees in the Department. A new Insect Pest and Plant Disease Act becomes effective September 18 of this year.

Dr. M. R. Smith, former Ant Specialist of the Mississippi State Plant Board, is now in charge of the Argentine ant survey work in the southern States for the Bureau of Entomology. By a cooperative arrangement, Dr. Smith is continuing to offer his courses in formicology at the Mississippi A. & M. College. He is being assisted in the survey work by T. F. McGehee, H. T. Vanderford, L. C. Murphree, and D. E. Read. Mr. McGehee has had several years' experience in entomological work with both the Bureau of Entomology and the Mississippi Plant Board. Mr. Vanderford had a temporary position during the past two summers at the oriental fruit moth laboratory at Cornelia, Georgia, and was employed as an inspector for the Mississippi Plant Board at the time of his appointment to the Argentine ant work. Mr. Murphree was employed during the past summer by the Plant Quarantine and Control Administration in corn borer scouting and was assisting in Argentine ant eradication campaigns in Mississippi at the time of his appointment. Mr. Read was previously employed by the Bureau of Entomology in pecan insect investigations at Brownwood, Texas, and later by the Plant Quarantine and Control Administration in Mediterranean fruit fly eradication in Florida.

Apiculture Notes

Professor E. F. Phillips spoke before the Virginia State Horticultural Society meeting in Winchester, Virginia, December 10 on the use of honeybees for fruit pollination. The meeting was held jointly with the Virginia Beekeepers' Association.

The Alabama Beekeepers Association met at Montgomery November 6th and 7th, in their annual meeting. Mr. R. M. Pugh, Provincial Apiarist of Regina, Saskatchewan, Canada, was the guest of the association. Problems of commercial beekeepers, such as package bee business, was especially emphasized.

The New York State Horticultural Society and the Empire State Beekeepers' Association held a joint meeting for the discussion of the use of honeybees in pollination in Rochester, January 13. The Beekeepers' Association prepared an exhibit among those planned in connection with the Horticultural Society meetings.

Professor and Mrs. E. F. Phillips of Cornell University will sail for Europe on February 4 and expect to spend the spring and summer visiting scientific institutions and points of interest in beekeeping on the continent. They will attend the International Congress of Entomology in Paris in July.

Mr. B. A. Slocum, Extension Specialist in Apiculture in the New York State College of Agriculture, has resigned in order to devote his entire time to graduate work. He has accepted a position in the University of Nanking, effective in September, 1932. Mr. George H. Rea has been appointed to fill the vacancy thus created, his appointment being effective January 1, 1932.

On October 15, A. P. Sturtevant, of the Loraine Bee Culture Laboratory, made a trip to Cheyenne, Wyo., to prepare for the winter the two bee colonies located at the Great Plains Horticultural Field Station. He reports: "It was interesting to note that, under conditions of rather scarce nectar supply found in Cheyenne, the Italian colony, during the summer, made a net gain of 88 pounds and 14 ounces, while the Caucasian colony made a net gain of 159 pounds and 14 ounces, the latter being the weaker colony at the time of locating the two colonies at Cheyenne."

At Yerington, Nev., E. L. Sechrist, of the Davis, Calif., Bee Culture Laboratory, participated in a school on honey grading, giving members of the Nevada Honey Producers Association instruction in grading comb honey according to United States Standard Grading rules. This school was arranged for by George G. Schweiss, Director of Plant Industry of Nevada. L. E. Cline, Extension Specialist in Marketing for Nevada; L. S. Fenn, Assistant Marketing Specialist of the Bureau of Agricultural Economics, U. S. D. A., of Salt Lake City; and Otto R. Schulz, District Extention Agent, Yerington, Nev., also participated, Mr. Fenn having come on from Salt Lake City for that purpose. About 15 members of the Nevada Honey Producers Association were in attendance. Supers and samples of honey were graded and the rules explained with apparent satisfaction to the Association.

Notes on Medical Entomology

On October 28 and 29 R. W. Wells, Galesburg, Ill., in company with Dr. K. W. Stouder, Extension Veterinarian of Iowa State College, visited a number of farms and examined many horses within both treated and untreated areas in the State.

On October 15 an airplane survey was made of the bodies of water in Lane County, Oreg., which are responsible for Anopheline breeding. It was estimated that about 250 acres of water surface were involved. All of these are elongated oxbows which have been caused by meanderings of the Williamette River. None are more than a few hundred feet in width.

During the latter part of September, Mr. Eric Hearle, Entomological Branch, spent several days at Jasper Park, Alberta, in connection with the control of mosquitoes and blackflies at Jasper Park Lodge. While in Jasper, Mr. Hearle interviewed the General Superintendent of the Canadian National Hotel System, and took the opportunity of making collections of blackfly larvae and pupae from streams in the district.

W. E. Dove and John B. Hull, Bureau of Entomology, Charleston, S. C., made a field trip in October to Savannah, Ga., Jacksonville, Tampa, Fort Pierce, and New Smyrna, Fla., for collections and data on the incidence of sand-flies. Collections were made of soil samples and adult sand-flies. Tentative plans were made for some intensive studies on breeding places of sand-flies at Jacksonville and Fort Pierce, Fla., during this winter.

H. H. Stage, Assistant entomologist at the Portland, Oreg., field laboratory, reports that he attended several conferences in October and made several trips with members of the Portland Chamber of Commerce Committee and the Director of the Civic Emergency Committee for the purpose of outlining a plan for clearing up the willow brush over several thousand acres of bottom land. He attended two conferences in Eugene relative to the malaria situation in Lane County, and suggested a plan, and outlined a budget for 1932.